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A TREATISE

ON

THE DISEASES

OF

INFANCY AND CHILDHOOD.

BY

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SEVENTH EDITION, THOROUGHLY REVISED.

WITH FIFTY-ONE ILLUSTRATIONS.

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610

PREFACE.

SINCE the issue of the Sixth Edition of this treatise in 1886 so many additional facts have come to light relating to the etiology, nature, and treatment of the diseases of children that the necessary revision has produced virtually a new book. In the amount of information presented, the work may properly be considered to have doubled in size, but this real growth has been accommodated without rendering the volume inconveniently large. The author has been careful in rewriting to exclude all obsolete material, and to condense the text to the limits of clearness. Among the diseases treated of in this and not in the former editions we may mention Conjunctivitis, Icterus, Sepsis, Umbilical Diseases, Hæmatemesis, Melæna, Sclerema, Œdema, and Pemphigus of the new-born; Epilepsy, Tetany, Appendicitis, Typhlitis, and Perityphlitis. The paper on Intubation, by Dr. Joseph O'Dwyer, will be found interesting and instructive to those who perform this operation, as well as to those who wish to learn how to do it.

In order to make the book in the highest degree useful to the practitioner prevalent and fatal diseases have been described at considerable length, and special attention has been bestowed upon the treatment. Modes of treatment employed by physicians of world-wide reputation are in many instances related, and cases are detailed showing the effects of remedies. Recent investigations and discoveries relating to the bacterial origin of the local as well as constitutional diseases of early life have necessitated many changes in the text, and it is believed that all the important facts relating to the diseases treated of, brought to light by recent researches, are set forth in the proper chapters.

J. L. S.

NEW YORK, September, 1890.

LIST OF ILLUSTRATIONS.

FIG. PAGE
1. Congenital Deformity 38
2. Milk-Globules 48
3. Colostrum-Corpuscles 48
4. Protuberant Abdomen in Rachitis 93
5. Acrania 97
6. Meningocele 99
7. Spina Bifida 101
8. Epithelium covered by Spores of Oïdium Albicans 147
9. Spores and Branches of the Oïdium Albicans 147
10. Skeleton of Congenital Rachitis 181
11. Head of the Rachitic Child 192
12. Rachitic Spinal Curvature 193
13. Rachitic Deformities 194
14. Rachitic Deformity of Chest 195
15.
16. Pelvic Deformities 196
17.
18.
19. Rachitic Deformity of Femur 196
20.
21. Deformities of Femur, Tibia, Fibula 197
22. Scrofulous Dactylitis 209
23. Case of Strumous Inflammation of the Joints 216
24. Bronchial Phthisis 229
25. Bacillus Tuberculosis 239
26. Syphilitic Dactylitis 258
27. Syphilitic Teeth 259
28. Partial Collapse of Lung from Pertussis 438
29. Bacillus Typhosus 457
30. Cerebro-Spinal Fever 483
31. Rheumatic Subcutaneous Nodules 508
32. Section of Rheumatic Nodule Magnified 508
33. Chronic Rheumatism 509

FIG. PAGE
34. Congenital Hydrocephalus 543
35. Congenital Hydrocephalus 545
36. Acquired Hydrocephalus 550
37. Tetany 559
38. Tetany 602
39. Facial Paralysis 630
40. Pseudo-Hypertrophic Paralysis 632
41. Intubation Instruments 669
42. Catarrhal or Lobular Pneumonia 692
43. Catarrhal or Lobular Pneumonia of a More Severe Grade 693
44. Croupous Pneumonia 695
45. Septic or Embolismal Pneumonia 696
46. Gangrene of the Mouth 746
47. Intussusception 841
48.
49.
50.
51. } Acarus Scabiei 890

CONTENTS.

PART I.

CHAPTER I.

PAGE
INFANCY AND CHILDHOOD 33

CHAPTER II.

CARE OF THE MOTHER IN PREGNANCY 35

CHAPTER III.

MORTALITY OF EARLY LIFE: ITS CAUSES AND PREVENTION 39

CHAPTER IV.

WEIGHT, GROWTH, LACTATION 43

Wet-Nursing: its Advantages and Hindrances; Physical Conditions rendering it Improper—Colostrum—Human Milk—Modification of Milk in Consequence of the Diet—Modification of Milk from its Retention in the Breast—Modification of Milk by Age and by Mental Impressions—Modification of Milk by the Catamenial Function, Pregnancy, and Other Causes—Effect of Medicines on the Mother's Milk—Differences in Women as regards Quantity and Quality of Milk—Rules in regard to Suckling—Scantiness of Milk: its Causes and Treatment.

CHAPTER V.

SELECTION OF A WET-NURSE 59

CHAPTER VI.

COURSE OF WET-NURSING—WEANING 62

CHAPTER VII.

QUANTITY OF FOOD REQUIRED IN INFANCY AND CHILDHOOD 64

CHAPTER VIII.

ARTIFICIAL FEEDING 72

CHAPTER IX.

PAGE
BATHING, CLOTHING, SLEEP, EXERCISE 80

CHAPTER X.

DIAGNOSIS OF INFANTILE DISEASES 85

General Observations—Features, External Appearance of the Head, Trunk, and Limbs in Disease—Attitude—Movements—The Voice—Respiratory System—Circulatory System—Animal Heat—Digestive System—Nervous System.

CHAPTER XI.

THERAPEUTICS 95

PART II.

DISEASES OF THE NEW-BORN.

CHAPTER I.

MALFORMATIONS 97

Acrania—Incomplete Brain—Meningocele, Encephalocele, Hydrencephalocele—Spina Bifida—Congenital Abnormalities in the Circulatory System—Malformations of the Heart—Cyanosis—Caput Succedaneum—Cephalæmatoma.

CHAPTER II.

DISEASES OF THE NEW-BORN 118

Inflammation of the Sterno-Cleido-Mastoid Muscle—Mammary Glands—Mastitis—Conjunctivitis—Umbilical Vegetations—Umbilical Hemorrhage.

CHAPTER III.

DISEASES OF THE NEW-BORN (*Continued*) 132

Icterus Neonatorum—Sepsis of the New-born—Thrush.

CHAPTER IV.

HÆMATEMESIS AND MELÆNA NEONATORUM 150

Diarrhœa of the New-born—Constipation of the New-born.

CHAPTER V.

TETANUS NEONATORUM 159

Sclerema Neonatorum—Œdema Neonatorum—Pemphigus Neonatorum.

PART III.

CONSTITUTIONAL DISEASES.

SECTION I.

DIATHETIC DISEASES.

CHAPTER I.

PAGE
Rachitis 179

CHAPTER II.

Scrofula 205

CHAPTER III.

Tuberculosis 221

CHAPTER IV.

Syphilis 251

SECTION II.

ERUPTIVE FEVERS.

CHAPTER I.

Measles 263

CHAPTER II.

Scarlet Fever 271

CHAPTER III.

Rötheln 328

CHAPTER IV.

Variola—Varioloid 336

CHAPTER V.

Vaccinia 345

CHAPTER VI.

Varicella . . . .

CHAPTER VII.

PAGE
DIPHTHERIA 356

CHAPTER VIII.

PERTUSSIS 431

CHAPTER IX.

MUMPS 445

SECTION III.

OTHER GENERAL DISEASES.

CHAPTER I.

INTERMITTENT FEVER 449

CHAPTER II.

REMITTENT FEVER 454

CHAPTER III.

TYPHOID FEVER 456

CHAPTER IV.

CEREBRO-SPINAL FEVER 470

CHAPTER V.

ACUTE RHEUMATISM 503

CHAPTER VI.

ERYSIPELAS 512

PART IV.

SECTION I.

DISEASES OF THE CEREBRO-SPINAL SYSTEM.

CHAPTER I.

MICROCEPHALUS—ATROPHY OF BRAIN 522

CHAPTER II.

PAGE
Hypertrophy of Brain 523

CHAPTER III.

Thrombosis in the Cranial Sinuses (Phlebitis) 527

CHAPTER IV.

Congestion of the Brain 531

CHAPTER V.

Intracranial Hemorrhage (Meningeal Hemorrhage, Cerebral Hemorrhage) 534

CHAPTER VI.

Congenital Hydrocephalus 542

CHAPTER VII.

Acquired Hydrocephalus 548

CHAPTER VIII.

Meningitis (Tubercular and Non-Tubercular) 551

CHAPTER IX.

Spurious Hydrocephalus 566

CHAPTER X.

Eclampsia 570

CHAPTER XI.

Epilepsy 578

CHAPTER XII.

Internal Convulsions (Spasm of the Glottis; Laryngismus Stridulus) 590

CHAPTER XIII.

Tetany 597

Chorea 608

CHAPTER XV.

PAGE
PARALYSIS 621

CHAPTER XVI.

POLIOMYELITIS ACUTA ANTERIOR 624

CHAPTER XVII.

FACIAL PARALYSIS 630

CHAPTER XVIII.

PSEUDO-HYPERTROPHIC PARALYSIS 631

CHAPTER XIX.

DISEASES OF THE SPINAL CORD AND ITS COVERINGS 634

CHAPTER XX.

CONGESTION OF THE SPINAL CORD AND ITS MEMBRANE 635

CHAPTER XXI.

VERTEBRAL CARIES 637

SECTION II.

DISEASES OF THE RESPIRATORY SYSTEM.

CHAPTER I.

CORYZA 641

CHAPTER II.

LARYNGITIS 644
Catarrhal Laryngitis—Spasmodic Laryngitis.

CHAPTER III.

MEMBRANOUS CROUP (DIPHTHERITIC CROUP; TRUE CROUP) 650

CHAPTER IV.

INTUBATION 667
Tracheotomy.

CHAPTER V.

BRONCHITIS 677

CHAPTER VI.

PAGE
ATELECTASIS 687

CHAPTER VII.

PNEUMONIA 690
Catarrhal Pneumonia—Croupous Pneumonia—Septic or Embolismal Pneumonia —Cheesy Pneumonia.

CHAPTER VIII.

PLEURISY 704

CHAPTER IX.

NERVOUS COUGH 737

SECTION III.

DISEASES OF THE DIGESTIVE APPARATUS.

CHAPTER I.

SIMPLE STOMATITIS, ULCEROUS STOMATITIS, FOLLICULAR STOMATITIS 739
Simple or Catarrhal Stomatitis—Ulcerous Stomatitis—Aphthous Stomatitis.

CHAPTER II.

GANGRENE OF THE MOUTH 744

CHAPTER III.

DENTITION 750
Second Dentition.

CHAPTER IV.

CATARRHAL PHARYNGITIS, PERIPHARYNGEAL ABSCESS, ŒSOPHAGITIS 756

CHAPTER V.

INDIGESTION, CONGESTION OF STOMACH, GASTRITIS, FOLLICULAR GASTRITIS, DIPHTHERITIC GASTRITIS, GASTRO-MALACIA 765

CHAPTER VI.

GASTRO-INTESTINAL BACTERIA 779

CHAPTER VII.

SIMPLE DIARRHŒA 781

CHAPTER VIII.

INTESTINAL CATARRH OF INFANCY (ENTERO-COLITIS) . . . .
Cholera Infantum, or Choleriform Diarrhœa.

CHAPTER IX.

PAGE
ENTERITIS AND COLITIS IN CHILDHOOD 808

CHAPTER X.

CONSTIPATION 811

CHAPTER XI.

INTESTINAL WORMS 822

CHAPTER XII.

INTUSSUSCEPTION 837

CHAPTER XIII.

APPENDICITIS, TYPHLITIS, PERITYPHLITIS 856

SECTION IV.

DISEASES OF THE GENITO-URINARY ORGANS.

Uric-Acid Infarctions—Enuresis—Calculi; Dysuria; Cryptorchia—Vulvitis . . . 866

SECTION V.

SKIN DISEASES.

CHAPTER I.

ERYTHEMATOUS DISEASES 877
Erythema—Roseola—Urticaria.

CHAPTER II.

PAPULAR DISEASES 882
Strophulus.

CHAPTER III.

ECZEMA 883
Scabies.

THE
DISEASES OF CHILDREN.

PART I.

CHAPTER I.

INFANCY AND CHILDHOOD.

INFANCY and childhood are, in certain respects, the most important and interesting periods of life. To the physiologist they are especially interesting, because they are the periods of development and of greatest functional activity; to the pathologist, because in them many diseases occur which are rarely or never observed in the other periods, or which present in these periods peculiar features; to the physician and vital statistician, because in them there are the greatest amount of sickness and largest number of deaths.

INFANCY extends from birth to the age of two and a half years, or till the completion of first dentition. In infancy the organs are delicately organized, containing a large proportion of water, and hence are easily injured. In this period the brain is rapidly developed—more so than any other organ; animal matter predominates in the bones; the arteries are relatively large, the muscles small; the superficial veins are small. Fat is absent from the interior of the body, but abundant, in well-nourished infants, underneath the integument. The skin is delicate, and its temperature not much below that of the blood. At birth it has a reddish hue and is covered with soft, fine hairs (lanugo). The reddish hue gradually fades into the healthy tint of infancy, and the hairs fall out. In the first two months the sweat-glands have little functional activity, sensible perspiration being quite rare. Subsequently, perspiration is freer, and in certain diseased states (rachitis, etc.) is abundant. The sebaceous glands in the first half of infancy are active, particularly upon the scalp, producing often a pale-yellow incrustation consisting of sebaceous matter and epidermic cells.

The secretions from the mucous surfaces commence at an early period. At birth the surface of the digestive tube is covered with more or less mucus, often in considerable quantity. The meconium is not considered, as formerly, to be [illegible] intestinal secretion. It consists of flat epithelial cells [illegible] tals of cholesterin, and brownish or yellowish [illegible] from the liver. It is supposed that, with the exception of the coloring matter, the meconium is derived mainly from the amniotic fluid which the fœtus has swallowed.

The most wonderful change occurring in the system at birth, through the exigencies of the new life, is that in the circulation. The flow of blood being interrupted, thrombi form in the umbilical vein and arteries and in the ductus arteriosus and ductus venosus, and these vessels gradually atrophy, becoming finally shrivelled but permanent cords. I have many times at autopsies removed the plug from the ductus arteriosus when death had occurred as late as the third week. The foramen ovale closes slowly. I have ordinarily found it open till near the end of the first half year, but the valve covers fully the aperture, so that there is no detriment to the circulation. Both the pulse and respiration are more frequent during infancy than childhood, and are more accelerated by moral and physical causes.

The stomach has a smaller relative size and emesis is more readily caused than in the adult. The liver is large, occupying at birth nearly half of the abdominal cavity, but it grows smaller in successive months. The appetite is good and digestion active, so that hunger, when appeased, soon returns. The thymus gland, at birth about the size of an unexpanded lung, slowly atrophies, but it does not totally disappear till after infancy.

The kidneys, distinctly lobulated at birth, gradually change their form, so as to present in the last part of infancy nearly the shape of the organ in the adult. The renal secretion commences early, even before birth. The kidneys seldom undergo degenerative changes as in the adult, but they are liable to congestions and inflammations. During the first month, and especially the first fortnight, crystals of uric acid and the urates are often found in the urine in a state of apparent health, causing more or less fretfulness in their elimination, staining the diaper, and not infrequently being arrested in the tubules of the pyramids, where they can be seen as pink-colored spots or lines (uric-acid infarction). These deposits of uric acid and the urates may even occur in the fœtus, producing obstruction and inflammation of the renal tubes. Congenital cystic degeneration of the kidneys is, in the opinion of Virchow, due to them. In early infancy the senses are imperfectly developed, the eyes being attracted only by bright objects and the sense of hearing affected only by loud noises. Sleep is the normal state in the first weeks of life: as the age of the infant increases, less and less sleep is required; but the oldest *infants* need more than children and several hours more than adults.

The new-born infant is apparently destitute of mental faculties. It seeks the breast by instinct, and it exhibits no perception or reflection. The loud cries with which it commences its existence are not from anger or suffering; they appear to be normal, like the act of nursing, and providentially designed in order to expand the lungs. It is not till the close or near the close of the first month that the gray substance of the brain begins to appear—the probable seat of the mind and the source of all mental phenomena. Perception and curiosity are early manifested. The infant, as Edmund Burke has remarked, is constantly seeking new objects for its amusement, rejecting old playthings for such as possess more novelty. Reflection, a higher faculty of the mind, appears at a later period. The mind and the bodily organs in infancy are, in a high degree, impressionable. Anger is excited by trivial causes, but is easily appeased, and the various functions in the system are disturbed by agencies which in youth or manhood would have no appreciable effect.

CHILDHOOD extends from infancy to the age of fifteen years or puberty. It is a period of great physical activity and of rapid growth. The functions of the various organs are performed with more moderation than in infancy, and are less frequently deranged. The volume of the brain continues to increase rapidly, and it becomes firmer than in infancy. It is estimated that by the seventh year the weight of this organ has doubled. The mind now exerts a controlling influence over the actions of the individual. The digestive organs have changed, so that solid food is required. Most of the glandular organs are less active than in the greater part of infancy, and some of them, as the liver, are relatively smaller. The pulse and respiration gradually become less frequent as the child advances in age.

CHAPTER II.

CARE OF THE MOTHER IN PREGNANCY.

THE frequency of miscarriages and stillbirths, and the large number of ill-formed and puny infants born to a precarious and short existence, render imperative, on the part of the mother, a strict observance of the laws of health, and an avoidance of all exciting or perturbating influences during the time when the fœtus is being developed. The diet should be plain and easily digested, but nutritious. There is often a craving in pregnancy for unusual articles of food. These may sometimes be allowed within certain limits, provided that they are such as do not derange the stomach. Meats and animal broths, together with vegetables and farinaceous food, should constitute the ordinary diet and should be taken at regular intervals.

Daily exercise, never violent, but moderate and gentle, is requisite. No exercise is better, none safer, and more likely to contribute to cheerfulness and healthy functional activity of the organs, than the ordinary household duties. Lifting heavy weights or work which, like washing and ironing, causes great and continued action of the abdominal muscles, should be avoided. Such exercise is highly injurious, and it may produce premature labor. Exercise in the open air on foot or by an easy conveyance conduces to the health of the mother and the growth and development of the fœtus. On the other hand, rapid riding over rough roads is one of the most dangerous modes of exercise. It has been known to destroy the fœtus, which up to that time had been apparently vigorous. When such a result occurs there is probably more or less detachment of the placenta.

It being a matter of the utmost importance that the health of the mother should continue good during gestation, any disease which she may have in this period, and which affects her nutrition or the character of her blood, should be promptly cured if practicable, and with the least possible reduction of the vital powers. Intermittent fever, occurring during gestation, should never be allowed to continue. It seriously retards fœtal development and may produce miscarriage. Unless it be controlled by proper measures, the offspring, though born at term, is puny and emaciated. Syphilis in the pregnant woman also requires treatment. This disease, readily transmitted from the mother to the fœtus through the ovum or the uterine circulation, may be eradicated by antisyphilitic treatment of the mother, or at least so modified that the infant is born vigorous and healthy.

The pregnant woman should avoid all causes of undue mental excitement. This is almost as necessary as the avoidance of great physical exertion. There is, during pregnancy, unusual susceptibility to mental impressions, and this should be borne in mind not only by the woman herself, but by those who associate with her.

Strong emotions, whether of joy, sorrow, or anger, affect primarily the nervous system, but indirectly most of the organs of the body. Observations have long established the fact that such emotions influence the state and functions not only of the digestive and glandular, but also of the muscular, organs, as the heart and uterus. Physicians are familiar with cases in which vivid mental impressions produced uterine contractions, and even miscarriage, or have disturbed the catamenial function. Therefore, the associations and cares of pregnant women should be such as conduce to cheerfulness and equanimity.

It is the popular belief and the belief of many physicians that vivid mental impressions sometimes have a direct effect on the development of the fœtus. Many cases are on record in which infants were born with marks or deformities corresponding in character with objects which had been seen and had made a strong impression on the maternal mind at some period of gestation. Whether the mind of the mother exerts a controlling influence on the form and color of the fœtus is a subject of great interest to the psychologist as well as the physiologist and physician, since it involves no less a question than the power and scope of the human mind. Violent emotions, it is admitted, may affect directly most of the important organs in the system. They may derange the liver, causing jaundice, accelerate, or for a moment suspend, the heart's action, stimulate the kidneys, causing diuresis, or even the intestinal follicles, causing watery evacuations. But with all these organs the brain is connected by nerves which anatomy reveals. On the other hand, the mother and fœtus have a distinct existence as regards their nervous systems, and even their blood. Still, the multitude of facts which have accumulated justify the belief that deformity or other abnormal development of the fœtus is, at times, due to the emotions of the mother. Some of the cases related by Dr. Whitehead in his work on hereditary diseases are very striking and difficult to explain on the ground of coincidence. I have met the following cases: An Irish woman of strong emotions and superstitions was passing along a street in the first months of her gestation, when she was accosted by a beggar, who raised her hand, destitute of thumb and fingers, and in "God's name" asked for alms. The woman passed on, but reflecting in whose name money was asked, felt that she had committed a great sin in refusing assistance. She returned to the place where she had met the beggar, and on different days, but never afterward saw her. Harassed by the thought of her imaginary sin, so that for weeks, according to her statement, she was made wretched by it, she approached her confinement. A female infant was born, otherwise perfect, but lacking the fingers and thumb of one hand. The deformed limb was on the same side as, and it seemed to the mother to resemble precisely, that of the beggar. In another case which I met a very similar malformation was attributed by the mother of the child to an accident occurring to a near relative which necessitated amputation during the time of her gestation. I examined both of these children with defective limbs, and have no doubt of the truthfulness of the parents. In May, 1868, I removed a supernumerary thumb from an infant whose mother, a baker's wife, gave me the following history: No one of the family and no ancestor, to her knowledge, presented this deformity. In the early months of her gestation she sold bread from the counter, and nearly every day a child with double thumb came in for a penny roll, presenting the penny between the thumb and the finger. After the third month she left the bakery, but the malformation was so impressed upon her mind that she was not surprised to see it reproduced in her infant. Mrs. S——, West Fiftieth street, New York, when in the seventh week of gestation saw a child with fingers united, so that they resembled the palm of the hand extended. She was much excited at the appearance, and clutched the window-sill with such force as to cause abrasion of the fingers. The malformation of the child made a deep and lasting impression on her mind, and her child, born at term, had the index, middle, and ring fingers of the left hand webbed and ending with the first phalanges, while the little finger was normal. Mrs. D——, Eighth avenue, New York, seven months before the birth of her child, when visiting at a distance, accidentally broke the plate of a full set of upper teeth. The line of fracture was antero-posterior and through the centre of the plate. Being away from home, she was much annoyed by the accident, and retained the fragments of the plate *in situ* by pressure with the tongue. As she could not open her mouth without the plate falling out, except it was retained by pressure with the tongue, her mind was dwelling almost constantly on the accident during the few days of her visit. Her boy, born seven months subsequently, had a hare-lip and cleft palate. The mother stated that the deficiency in the lip and palate corresponded precisely to the location of the fracture in the plate. Dr. Greenley relates five similar cases in which infants at birth presented marks or arrested development corresponding in appearance with objects which produced strong mental impressions in the mothers (*Amer. Prac. and News*, Oct. 29, 1887).

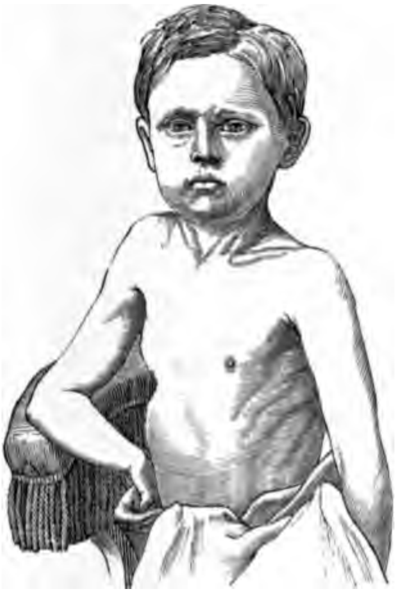
Dr. William A. Hammond of Washington, in an interesting paper on the "Influence of the Maternal Mind," etc. (*Quarterly Journal of Physiological Medicine*, January, 1868), says: "The chances of these instances, and others which I have mentioned, being due to coincidence are infinitesimally small, and though I am careful not to reason upon the principle of POST HOC, ERGO PROPTER HOC, I cannot, nor do I think any other person can, no matter how logical may be his mind, reason fairly against the connection of cause and effect in such cases. The correctness of the facts can only be questioned; if these be accepted, the probabilities are thousands of millions to one that the relation between the phenomena is direct." Professor Dalton also says (*Human Physiology*): "There is now little room for doubt that various deformities and deficiencies of the fœtus, conformably to the popular belief, do really originate in certain cases from nervous impressions, such as disgust, fear, or anger, experienced by the mother." The observations on which this belief is based relate both to man and the lower animals. A very strong argument in its support is, as Professor Hammond remarks, the popular opinion, which dates back to the time of Jacob (Genesis xxx.). An almost universal sentiment, running through centuries, is rarely wholly fallacious. It has some truth for its foundation, especially when, as in this instance, the subject is one of observation.

If maternal emotions affect the development of the exterior of the fœtus, as observations show and physiologists admit, the presumption is strong that they may affect also the proper development and adjustment of the parts of the brain, an organ so complex and delicate, and may therefore give rise to idiocy. Dr. Seguin (*Idiocy and its Treatment*, etc., New York, 1866) thus remarks on this point: "Impressions will sometimes reach the fœtus in its recess, cut off its legs or arms, or inflict large flesh wounds before birth, ... from which we surmise that idiocy holds unknown though certain relations to maternal impressions as modifications to placental nutrition."

In volume i. of the *Cyclopædia of Diseases of Children* (Philadelphia, 1889) Dr. W. C. Dabney has published the statistics of 90 cases showing that both mental and bodily defects in the infant sometimes result from vivid mental impressions in the mother during the early months of her gestation. These cases are mostly collated from recent medical literature, and many of *them are striking instances showing* the effect of maternal impressions in causing malformations in the fœtus, not only in the human race, but also in quadrupeds. Dr. Dabney also relates the remarkable statement of Baron Larrey, that 92 *enceinte* women who had experienced the extreme mental and physical suffering of the siege of Landau in 1793 brought forth infants with the following result: born dead, 16; born alive, but dying in ten months, 33; born idiotic, 8; born with bones ununited or in a fragmentary state, 2.

It is an interesting fact that abnormalities of structure occurring from whatever cause are sometimes propagated to descendants. Dr. Carpenter and others relate instances among the lower animals, and similar instances of transmission have now and then been observed in the human race. Thus, in the issue of *Nature* for March 7, 1878, it is stated on the authority of M. Lenglen, a physician of Arras, that a certain M. Gamelon in the last century had two thumbs on each hand and two great toes on each foot: this peculiarity did not appear in the son, but it reappeared in the three succeeding generations, so that some of the great-great-grandchildren possessed it in as marked a degree as their ancestors.

FIG. 1.



In view of such important facts the duty of the pregnant woman is rendered the more imperative to avoid the presence of disagreeable and unsightly objects, as well as all causes of excitement, and to remove, as soon as possible, vivid and unpleasant impressions by quiet diversion of the mind.

The disastrous results upon the fœtus of severe injuries received by the mother are well known to the profession, for premature labor and death of the child or feebleness from its prematurity are common results of such accidents. In rare instances the child may be so injured as to be deformed for life, as in the following interesting case: Richard L——, aged six years, came, in January, 1877, to the children's class in the Bureau for the Relief of the Out-door Poor. The following history was obtained: On November 27, 1870, one month before the birth of Richard, the mother fell heavily on the ice when stepping from a city car. Uterine hemorrhage resulted, which continued more or less freely, producing marked pallor, till her confinement, which occurred December 23d. The position of the child *in utero* was crosswise, but nothing untoward occurred in the delivery. Immediately after its birth, when it was being washed by the nurse, a blister about one inch in diameter was observed on the right side of the thorax, located about one inch below and two and a half inches externally to the nipple. A cicatrix resulted, which now marks the site of the sore. When the blister healed the child seemed entirely well, and nothing more was thought of the unusual occurrence of an intra-uterine vesication till nearly half a year had elapsed, when the thorax below the nipple and at the site of the cicatrix was observed to be depressed, and the depression has continued to the extent indicated in the woodcut.

The ribs at the point of depression are found to be widely separated, the rib below being pushed downward so as to form one side of the triangle, its cartilage the second side, and the rib above the hypothenuse. The distance of the perpendicular line passing from the costo-chondral articulation of the lower rib to the upper rib, or the hypothenuse, is two and a half inches by measurement. The depression in this triangular space evidently resulted gradually from the wide separation of the ribs, and the consequent loss of resiliency in the thoracic walls in the space destitute of bony support. The child lay crosswise *in utero*, and it seems probable that the injury was produced by the pressure of its arm against the ribs during the fall. Cases like the above, and the graver cases in which fœtal life is sacrificed or the child is born to a puny and uncertain existence from prematurity, show the very great importance of a quiet and regular life on the part of one who is about to become a mother; for bodily injuries, like unpleasant sights, occur when least expected.

CHAPTER III.

MORTALITY OF EARLY LIFE: ITS CAUSES AND PREVENTION.

No fact is better known in the profession than that the first years of life constitute the period of greatest mortality.

In England, where there is an accurate registration of births and deaths, statistics show fifteen deaths in every hundred infants in the first year of life, and between four and five deaths in the first month Statistics on the Continent correspond with those in England as regards the periods of greatest mortality. Quételet says: . . . . "There die during the first month after birth four times as many children as during the second month after birth, and almost as many as during the entirety of the two years that follow the first year, although even then the mortality is high. The tables of mortality prove, in fact, that one-tenth of children born, die before the first month has been completed."

In this country, in consequence of deficient registration of births, the percentage of deaths to births cannot be accurately ascertained. In this city 53 per cent. of the total number of deaths occur under the age of five years, and 26 per cent. under the age of one year. According to the census of 1865, there were in New York City 95,020 children under the age of five years, and during the five years ending with 1865, 49,000 children five years old and under had died. Therefore, according to these statistics, more than one-third of all the infants born in this city die under the age of five years. An error, however, occurs from the fact that, while the death-statistics were complete, it is known there were more children in the city than were embraced in the census returns. Still, it may, I think, be safely stated that one-fourth of the children born in this city die before the age of five years.

In less-crowded cities and the rural districts it is known that the percentage of deaths in the first years of life to the total number of deaths is considerably less than in New York City, but it is nevertheless large.

As the child advances toward puberty the liability to sickness and d gradually diminishes, but even the last years of childhood present a siderably larger percentage of deaths to the population than does yo manhood.

The causes of this great mortality of infants and children, and the *of diminishing it, deserve careful* consideration.

Some of the causes which conspire to produce it are to a considerable extent unavoidable. Such are congenital vices of formation of internal organs. Many of the internal malformations necessarily occasion an early death. Cases of anencephalus, most cases of congenital hydrocephalus, of spina bifida, of cyanosis, are fatal before the close of infancy. These defects of formation we cannot detect before birth, and their causes are often obscure. Some of them seem to result from inflammation, believed to be, occasionally, syphilitic, developed at some period of fœtal existence. Other internal malformations are attributable to perturbating influences operating temporarily on the mother during gestation. But in a large proportion of cases we cannot assign the cause. Obviously, only partial success can attend our efforts as regards prevention in these cases, and almost no success as regards the use of remedial measures.

Another obvious cause of the great mortality of early life is natural feebleness of system, especially in infancy. The younger the patient prior to the middle period of life, the sooner are the vital powers exhausted by disease. Hence a larger proportion of infants succumb to the same malady than children, and a larger proportion of children than adults. This statement is true of infancy and childhood in general. It is a law in nature, and cannot be changed by art. But there are many infants born with hereditary disease or a strong predisposition to disease through a fault which is, in a degree, curable, in the system of one or both parents; as, for example, the syphilitic, scrofulous, or tubercular diathesis. Parents seriously affected by such diseases cannot, without corrective treatment, have healthy offspring. Their children are among the first to droop and die, either directly from the inherited disease, or from feebleness of constitution which such disease entails, and which renders them an easy prey to other diseases. The duty of the physician as regards such parents is obvious. He may, by therapeutic and hygienic measures, secure a more healthy progeny, and so far as he can do this he aids in diminishing the infantile mortality. He may sometimes, by timely measures directed to the infant, establish a better state of health.

The subject of hereditary disease is one of great interest and importance, especially as regards the city population. Inherited affections are less common in the country, but in the city they contribute largely to the number of deaths in early life.

Another important cause of the great mortality of children is the fact that they are peculiarly liable to certain severe and fatal maladies. I allude particularly to the acute infectious diseases, which, as a rule, occur but once, and that in childhood. Some of them, as scarlet fever, greatly increase the number of deaths. They extend and become epidemic through the intercourse of children. We are constantly witnessing in New York the spread of the acute contagious diseases, especially of whooping cough, measles, scarlet fever, and diphtheria, through the schools. Measures employed, thus far, by boards of health or other local authorities to prevent the dissemination of these and kindred diseases have been but partially successful, except in regard to smallpox. In the large public schools especially these maladies are most frequently contracted, and from them they radiate over the school districts; for if, as is now common, at least in New York City, a child comes to school wearing clothes which at home have lain in a room where a brother or sister was sick with diphtheria or scarlet fever, or if he enter the class with a mild pertussis or measles, certain of his classmates will probably return home infected with the virus of the disease. The same remarks are applicable, though with less force, to private schools. From both such schools I have over and over again witnessed the dissemination not only of the maladies mentioned, but also of the milder infectious diseases, as mumps and varicella.

The Health Board of New York City has recently, by stringent enactments regulating the schools, accomplished much in suppressing this source of the infectious diseases.

In hospitals and asylums for children much can be done to prevent the occurrence of the infectious diseases by strict surveillance and prompt isolation of all suspicious cases. Without such care scarcely a year passes in which these institutions are not scourged by one or more of these diseases. Much has been said of the crowding of families in tenement-houses so common in New York and other large cities, by which a large number of children are brought under one roof, of the uncleanliness of person and apartment to which it leads, and of the insufficient air and space which it allows to each. But one of the strongest objections, in my opinion, to the present plan of building and crowding tenement-houses is the facility which it affords for the spread of the contagious diseases of childhood; and it is in such houses, as shown by statistics, that these maladies are the most frequent and fatal. The much-needed enactments or regulations in relation to the construction and occupancy of such houses would, among other salutary effects, greatly diminish the death-rate from the infectious maladies.

Over the most loathsome, and formerly the most fatal, malady of mankind—namely, smallpox—we now have, or can have, complete control by statutory enactments enforcing vaccination. It is only by carelessness or the lack of sufficiently stringent regulations relating to the matter that smallpox is not "stamped out." Again, some of the most fatal inflammatory diseases of life occur chiefly in childhood, as croup and capillary bronchitis. These and kindred diseases can only be prevented by proper hygienic management on the part of families, and the circulation of tracts or other means calculated to educate families in reference to the management of children cannot fail to diminish the number of cases of such inflammations, and, consequently, of the deaths from them.

Another obvious and important cause of the mortality of early life is the antihygienic condition or state in which many children live, in consequence of the poverty or gross negligence of parents.

Residence in insalubrious localities, personal and domiciliary uncleanliness, exposure without proper protection to vicissitudes of weather, are fertile causes of sickness and death. Hence one reason for the great infantile mortality among the city poor, who live in damp and dark alleys and in crowded and filthy tenement-houses, breathing night and day an atmosphere loaded with noxious gases. All physicians are aware how the most fatal diseases, such as Asiatic cholera, cholera infantum, diphtheria, and typhus fever, seek the quarters of the city poor, and what terrible havoc they make there. All are aware, also, what wonderful recoveries result when feeble and attenuated infants, gradually sinking with chronic diseases, induced in great measure by the foul air, are transferred from such localities to the pure air of the country.

Careless management of young children as regards dress increases greatly the liability to local diseases, such as commonly occur from exposure to cold. These are inflammatory affections seated chiefly upon the mucous surfaces, but sometimes in parenchymatous organs. Adults, aware of the effect of sudden change of temperature from warm to cold or of exposure to currents of air, protect themselves by additional clothing. Such precautionary measures are often lacking in the management of young children, and hence one cause of their great liability to local affections, both of the respiratory and digestive organs.

Routh, in his excellent treatise on *Infant Feeding*, says: "Among the *most pernicious influences to young* children, however, we may include cold;

the change of temperature from 45° to four or five below zero, as before stated, producing an increase of mortality in London alone of three to five hundred. As out of 100 deaths, however, from all specified causes, nearly 24 occur to children under one year, and 36 to children under five, the great increase of mortality to children by cold is thus at once made obvious. Indeed, it is a household word among us, which takes its origin from the Registrar-General's returns, that a very cold week always increases the mortality of the very young and the very aged."

Lastly, a very important cause of mortality in early life is the use of improper food. In infants artificial feeding in place of the aliment which nature has provided for them, and in children the use of innutritious or indigestible articles of diet, give rise to diarrhœal maladies, emaciation, and death in numerous instances. Sometimes, also, defective alimentation is the cause of scrofulous or tuberculous ailments, and sometimes it gives rise to a cachexia or feebleness of system which, without engendering any positive disease, renders those thus affected less able to support disease induced by other causes. A committee, of which Professor Austin Flint, Jr., was chairman, appointed in 1867 to revise the "dietary table of the children's nurseries on Randall's Island," states, with much truth and force: "Children . . . . are not capable of resisting bad alimentation, either as regards quantity, quality, or variety. At that age the demands of the system for nourishment are in excess of the waste, the extra quantity being required for growth and development. If the proper quantity and variety of food be not provided, full development cannot take place, and the children grow up, if they survive, into puny men and women, incapable of the ordinary amount of labor and liable to diseases of various kinds."

Improper feeding, like other causes of mortality, is much more injurious, much more frequently the cause of death, in the city than in the country. Statistics in Europe, as well as this side of the Atlantic, establish this fact. It is in infancy, and especially in the first year, that the use of unwholesome food entails the most serious consequences. No artificially-prepared food is a good substitute for the mother's milk, and hence artificial feeding of the infant, unless under the most favorable circumstances, results disastrously. In the country, where salubrious air and sunlight conspire to invigorate the system, where a robust constitution is inherited, and where cow's milk, fresh and of the best quality, is readily obtained, lactation is not so necessary for the well-being of the infant; but in the city its importance cannot be too strongly urged.

The foundlings of cities afford the most striking and convincing proof of the advantages of wet-nursing. In some cities foundlings are wet-nursed, while in others they are dry-nursed, and the result is always greatly in favor of the former. Thus, on the Continent, in Lyons and Parthenay, where foundlings are wet-nursed almost from the time that they are received, the deaths are 33.7 and 35 per cent. On the other hand, in Paris, Rheims, and Aix, where the foundlings were wholly dry-nursed, at the date of the statistics their deaths were 50.3, 63.9, and 80 per cent.

In New York City the foundlings, amounting to several hundred a year, were formerly dry-nursed, and, incredible as it may appear, their mortality with this mode of alimentation nearly reached 100 per cent. Now wet-nurses are employed for a portion of the foundlings, with a much more favorable result. Several years ago, before the New York Foundling Asylum existed, the foundlings of New York were taken care of by the pauper women of the almshouse, and the medical board of Charity Hospital assigned me to the service in the almshouse. Foundlings were received nearly every day, and were given cow's milk prepared by these pauper women. Incredible as it may seem, the deaths corresponded with the admissions: only one infant was pointed out that had survived the first half year in the almshouse.

These facts, to which others might be added from the experience of European cities, show the importance of wet-nursing as a means of reducing infantile mortality in the cities. What has been stated as regards the result of artificial feeding of foundlings is true, in great measure, in reference to all city infants. The ill-effect of artificial feeding is well known in this city, and it is the common practice in families to employ a hired wet-nurse if, for any reason, the mother's milk is insufficient.

When the infant has reached the age at which it is proper to wean, the digestive organs are less frequently deranged by errors of diet. More substantial food, and considerable variety in it, may now be not only safely allowed, but are required by the wants of the system. In infancy, therefore, the mortality is largely increased by improper diet, while in childhood the diet is a much less common cause of death.

CHAPTER IV.

WEIGHT, GROWTH, LACTATION.

Dr. K. Parker, resident physician of the New York Infant Asylum when these observations were made, weighed, immediately after birth, 170 infants—89 male and 81 female—born consecutively and at term, with the following result:

Average male weight	7 lbs. 11 oz.
" female "	7 " 4 "

Fifty of these, who were wet-nursed and apparently well taken care of, were weighed when one week old, with the following result:

Increase of weight in	32 cases.
Loss of weight in	13 "
Average gain	4$\frac{8}{10}$ oz.
" loss	3$\frac{1}{3}$ "
Greatest gain	12 "
" loss	6 "

AVERAGE GAIN.

From birth to age of 4 months (25 cases)	4 lbs. 8$\frac{3}{4}$ oz.
" 3 to 6 months (6 cases)	3 " 3$\frac{1}{6}$ "
" 6 to 9 " "	2 " 7$\frac{1}{6}$ "
" 9 to 12 " "	1 " 15$\frac{1}{2}$ "

It is desirable that the infant as soon as it requires nutriment should receive breast-milk. If it be fed for a few days with the bottle or spoon, it may be difficult finally to induce it to take the breast; therefore it is well to determine early whether the mother will be able to wet-nurse
so that, if unable, suitable provision may be made.

The matter of determining beforehand the capability of
wet-nursing has been investigated by Dr. Donné of Pari
on *Mothers and Infants* he describes the mode in whic
The desired information, in his opinion, may be acq

colostrum, which is secreted in small quantity, in the last months of gestation, and which can be squeezed from the breast in sufficient quantity for inspection.

In some women, according to Dr. Donné, the colostrum is so scanty that only a drop or half a drop can be obtained from the nipple by careful pressure. This will be found by the microscope to contain but few milk-globules, ill formed, and a few granular bodies, such as the colostrum ordinarily contains. Such women almost invariably furnish poor milk and in small quantity. In other women the colostrum is abundant, but thin, resembling gum-water; it lacks the yellow streaks and viscous character of ordinary colostrum, and it flows readily from the nipple. The milk of such women is sometimes scanty, sometimes abundant, but it is watery and deficient in nutritive principles. In a third class of women the colostrum is pretty abundant, and it contains yellowish streaks of more or less consistence, which are found to be rich in milk-globules of good size. Women furnishing such colostrum in the last weeks of gestation will have sufficient milk and of good quality. These latter women make the best wet-nurses.

WET-NURSING: ITS ADVANTAGES AND HINDRANCES; PHYSICAL CONDITIONS RENDERING IT IMPROPER.

During the first year of the infant's life the natural mode of alimentation—that by the mother's milk—should always be recommended, except in those instances in which mothers are incapacitated by physical ailments or mental derangement. The practice common in New York, and probably in other cities, of employing wet-nurses in the belief that suckling their infants deprives mothers of social enjoyments and by the drain upon the system impairs their general health, should be discouraged. Wet-nursing by the mother, if properly regulated, with sufficient undisturbed sleep at night, and with the maintenance of good appetite and digestion, does not impair her health, but, on the other hand, tends to promote her physical well-being. But there are unavoidable conditions which render wet-nursing by the mother injudicious or impossible. These will be considered hereafter.

The primipara often experiences difficulty in wet-nursing in consequence of a depressed state of the nipple. It is not sufficiently prominent to be readily grasped by the mouth, and after ineffectual attempts the infant becomes fretful when applied to the breast, and perhaps for a time refuses it altogether. Multiparæ occasionally experience the same inconvenience, but it is not common when there has once been successful lactation. By calmness and perseverance on the part of the mother the nursling can usually be made to seize the nipple in the course of a week.

Depression of the nipple is, to a certain extent, the result of pressure upon it by the dress during gestation. The state of the nipples should indeed, in those who have never suckled, receive early attention, even before the birth of the infant. Tightness of dress around the breast, as also upon every part of the body, should be avoided, and from time to time gentle traction should be made upon the nipple if it be depressed. It may be drawn out by the fingers of the mother several times each day, or by a common breast-pump, or by suction with a tobacco-pipe, the edge of the bowl having been smoothed. Occasionally, in these cases of depressed nipple the mother, fatigued and discouraged by her frequent ineffectual attempts to induce the infant to nurse, becomes feverish and excited, so that the quantity of her milk is sensibly diminished. The physician should assure her, as he usually can with confidence, that in a few days, as the baby becomes a little stronger, there will be no difficulty in its nursing. Some women are unremitting in their endeavors to procure nursing. This should be forbidden, since the lack of sleep and the nervousness which such constant endeavor produces tend to defeat the object which they have in view, by diminishing the secretion of milk. Sufficient sleep, freedom from anxiety, and no more frequent application of the infant to the breast than is required in successful lactation should be enjoined. Occasionally, we can best succeed in procuring lactation under these circumstances of discouragement by the aid of another infant older, more vigorous, and better able to seize the nipple. An exchange of infants a few times may remedy the difficulty.

Occasionally, suckling is rendered difficult and painful by too long delay before applying the infant to the breast. When the mother has rested a few hours after her confinement—about six in ordinary cases—lactation may commence. There is at first but very little milk, often only a few drops, but the secretion is promoted by nursing, so that the requisite amount is sooner obtained than when the infant is kept from the breast till the second or third day. If, as some physicians advise, suckling be deferred till the breasts are full and tender, and if, as is often the case with primiparæ, the nipples are also tender, many mothers lack the fortitude required to allow their infants to obtain a sufficient amount of milk. Excoriated and fissured nipples constitute a serious impediment to wet-nursing. They are very sensitive on pressure, and are long in healing. They are fully described in works which relate to female diseases, and their treatment pointed out. Occasionally, fissured nipples do harm to the infant by the blood which escapes and is swallowed with the milk. A case is related in which positive indigestion was caused in this way, the infant vomiting, after each nursing, milk mixed with blood. The local hindrances to lactation described above can in most instances be relieved in the course of a few weeks. To what extent menstruation and pregnancy are detrimental to the nursing, and therefore contraindicate lactation, will be considered in another section.

There is occasionally a constitutional state of the mother which necessitates either the employment of a hired wet-nurse or weaning. This is the case when there is a strong tendency to tuberculosis. If the complexion be pallid, the system at all emaciated, and suckling be attended by more or less exhaustion, and if with fair trial of wine and tonics no improvement follow, the physician is justified in forbidding further attempts at wet-nursing. If, under such circumstances, an hereditary tendency to tuberculosis exist, it is his duty positively to interdict nursing. The opinion of the physician in such a matter should be formed after mature deliberation. There are many women who, suffering temporarily from illness and discouraged, are ready at once to abandon their infants to the care of others with the least encouragement on the part of the physician to do so, but who, by attention to their own health, and especially by taking more sleep, soon recover from their depression and become good wet-nurses. On the other hand, night-sweats, a cough, and progressive decline in health show the need of immediate suspension of wet-nursing.

Sometimes women prior to pregnancy present indubitable evidence of tuberculosis, but by the improved general health which attends pregnancy the disease is temporarily arrested. Such women should never suckle their infants. If they do, they soon lose all that was gained and the disease advances rapidly. These objections to wet-nursing in such a state of health apply to the mother. There are also objections as regards th [illegible]
milk of those in decidedly infirm health is deficient in nu [illegible]
Their infants, therefore, are ill-nourished, and if they ha [illegible]
disposition to tuberculosis there is great danger that [illegible]

developed in them; whereas with healthy wet-nursing even a strong predisposition may remain latent. M. Donné relates the following instructive cases, which show the danger which sometimes attends suckling and the imperative necessity which may arise of discontinuing it: "A very light-complexioned young mother, in very good health and of a good constitution, though somewhat delicate, was nursing for the third time, and, as regarded the child, successfully. All at once this young woman experienced a feeling of exhaustion. Her skin became constantly hot; there were cough, oppression, night-sweats; her strength visibly declined, and in less than a fortnight she presented the ordinary symptoms of consumption. The nursing was immediately abandoned, and from the moment the secretion of milk had ceased all the troubles disappeared." "A woman of forty years of age . . . . having lost, one after another, several children, all of whom she had put out to nurse, determined to nurse the last one herself. . . . . This woman, being vigorous and well built, was eager for the work, and, filled with devotion and spirit, she gave herself up to the nursing of her child with a sort of fury. At nine months she still nursed him from fifteen to twenty times a day. Having become extremely emaciated, she fell at once into a state of weakness from which nothing could raise her, and two days after the poor woman died of exhaustion."

A very similar case recently occurred in my practice. A young and healthy woman from the country, suckling her second infant, on coming to the city lived in a dark and very imperfectly ventilated room on the first floor and in the rear of a crowded tenement-house. She soon lost her appetite, but continued suckling for three months, when she became so anæmic and feeble that she was compelled to seek medical advice. She died without local disease, notwithstanding the most nutritious diet and free use of stimulants and tonics.

Constitutional syphilis in the mother does not contraindicate wet-nursing. It is probable that the infant also has it. The mother should take antisyphilitic remedies, which will eradicate the disease in herself, and also, if it be present, in the infant. Febrile affections also do not in general contraindicate wet-nursing. They may, however, for a time diminish the quantity of milk or impair its quality. If, however, the mother be in a critical state or much reduced, whatever the disease, suckling should cease. Whether or not the infant should be taken from the breast if the mother be suffering from one of the essential fevers depends on the severity of the malady and the degree of her exhaustion. Twice I have known newly-born infants to be suckled by mothers while the latter had scarlet fever, without contracting it, but suffering immediately afterward from protracted and severe eczema. In rural localities, where artificially-fed infants, as a rule, do well, it might be best to wean if the mother have such a disease; but in the city eczema is less dangerous than the diarrhœal affections which early weaning is likely to entail. In most cases of typhus and typhoid fevers weaning or procuring a wet-nurse is necessary, on account of the depression of the vital powers which these diseases produce. Mothers with organic diseases, of whatever kind, which impair the general health or diminish the appetite, should never be allowed to wet-nurse their infants. Wet-nursing under such circumstances is likely to aggravate the disease, and the milk which such mothers furnish, even if sufficient in quantity, is deficient in nutritive properties.

Inflammatory affections, unless of a dangerous character, do not ordinarily interfere with wet-nursing, except that the quantity of milk is somewhat diminished. In severe inflammation it may be so necessary to husband the strength or to keep the patient perfectly quiet that suckling her infant would be injudicious. It should then be transferred to a wet-nurse or weaned. Inflammation of the breast often presents an impediment to lactation. It is a common and painful affection, suspending or greatly diminishing the secretion of milk in the affected gland. Wet-nursing should cease as soon as there are evident signs of inflammation, unless it be limited to a small part of the gland. General heat of the breast, with tenderness and induration extending over a considerable part of it, indicates the need of the immediate removal of the infant from it. Suckling must be restricted to the unaffected side. It is often the case that the volume of the inflamed gland is considerably increased from the afflux of blood to it and from the interstitial exudation, while it contains little or no milk, and attempts at suckling under such circumstances are injurious to the mother as well as to the infant. The cause of the swelling should be explained to the mother, who commonly attributes it to the accumulation of milk, and worries herself and the infant by attempts to make it nurse. As the inflammation abates by resolution, or more commonly by suppuration, and the normal secretion returns, the first milk, which is usually thick and stringy, should be rejected, after which the infant may nurse as usual. Occasionally, the abscess which has formed in the breast connects with a lactiferous tube, so that pus may, on suction, escape from the nipple. If this occur, of course nursing should be interdicted until pure milk is obtained. Pus in the milk can sometimes be detected by the naked eye. It presents a yellowish or greenish color, occurring in streaks when not intimately mixed with the milk. When it is intimately mixed and in small quantity, it cannot be detected by the naked eye, but the microscope reveals the pus-globules. M. Donné relates a case in which he discovered these globules by the microscope, although there were at first no other evidences of an abscess, and doubts were expressed in reference to the accuracy of his observation. Finally, an abscess pointed and discharged.

Sometimes when the inflammation abates the secretion does not return, and, worse still, occasionally the inflammation has occurred so near the nipple that the lactiferous tubes are permanently closed by it, so that, though milk form in the breast, there is no escape for it. Thenceforth only one breast can be used.

If erysipelas occur in the mother, the infant should be immediately taken from her breast and from her arms. If this disease should not be communicated to the infant through the milk or through fissures in the nipple, of which there is danger, still the milk usually undergoes such a change in consequence of the erysipelas as to endanger the health of the child. Thus, one of the wet-nurses in the New York Infant Asylum sickened with severe facial erysipelas on the 24th of April, 1875, eight days after the death of her baby. She was wet-nursing a foundling, aged seven weeks, at the time of the commencement of the erysipelas, and, as it was very important that her milk should be preserved for the coming hot months, it was deemed best to allow the nursing to continue, the infant being placed in a crib at a little distance as soon as it dropped the nipple. On the 27th the baby was troubled with diarrhœa. April 28th its morning temperature was 101°, and that of the evening 103°, the diarrhœa continuing. It was now removed entirely from the breast and was given artificial food. On the 29th there was a decided general icteric hue of the infant's surface, which continued till its death on May 1st. The stools numbered about eight daily till April 30th, when they ceased. The record which I preserved does not state whether there was vomiting, but it had probably been slight on account of the speedy prostration. Death occurred from exhaustion. At the autopsy from half an ou
to one ounce of pus was found in the peritoneal cavity, newly-forme
was observed upon the spleen and liver, and the peritoneum gene

lost much of its lustre: a careful microscopic examination of the liver and its ducts, made by Dr. Heitzmann, revealed no anatomical change which would explain the icteric hue, and it seemed probable that this was due to the altered state of the blood. The mucous membrane of the intestines exhibited vascular streaks and its follicles were distinct. The lesions, therefore, indicated intestinal catarrh. Nothing unusual was observed in the heart and lungs of the infant. Its life had been apparently sacrificed by the unhealthy nursing.

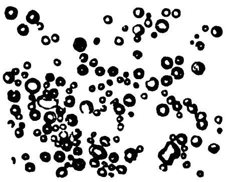
COLOSTRUM.

The milk secreted during gestation, and immediately after the birth of the infant, ordinarily differs in its gross appearance, as well as chemical and microscopical characters, from that which is subsequently secreted. It is termed COLOSTRUM. It has a turbid and yellowish appearance, and is somewhat viscid. It is decidedly alkaline, and undergoes lactic-acid fermentation more readily than common milk, and it also contains more solid matter. It has an excess of fat, of salts, and, according to Simon, also of sugar. It appears from Simon's analysis that the solid matter of colostrum is about 17 per cent., while that of the ordinary breast-milk is about 11 per cent.

Examined by the microscope, the colostrum is seen to contain oil-globules and a viscid substance which often assumes an ovoid or globular form, but which also exists in irregular masses of considerable size. This substance has been thought by some to be mucus, but it is dissolved by acetic acid and potash and is tinged yellow by a watery solution of iodine. It is therefore to be regarded as albuminous. Imbedded in this substance are oil-globules, which are for the most part of small size, while the free oil-globules of colostrum are larger than those occurring in healthy milk. The viscid substance, with the imprisoned oil-globules, constitutes what has been designated the "colostrum-corpuscles." Some have erroneously considered the "colostrum-corpuscles" to be compound granular cells. The compound granular cell or corpuscle is a cell which has undergone fatty degeneration. It is distended with oil-globules to perhaps twice or thrice its normal size. On the other hand, examination of the "colostrum-corpuscles" fails to detect a cell-wall, and the large and irregular size of some of these corpuscles negatives the idea that they are cells. The oil-globules contained in the viscid substance are more readily acted on by ether than are the free oil-globules.

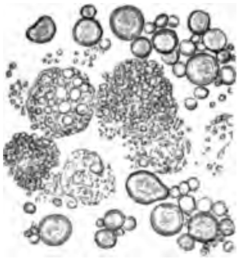
The colostrum is replaced by milk of the normal character in six to eight days, sometimes as early as the third or fourth day after delivery. In exceptional instances the colostrum does not disappear for several weeks, and it may reappear at any time subsequently as a consequence of derangement of

FIG. 2.



Milk-globules.

FIG. 3.



Colostrum-corpuscles.

the system or from disease. It is assimilated with difficulty by the digestive organs of the infant, producing usually a laxative effect. It therefore aids in the removal of the meconium, and, being a normal secretion, it is to be regarded as beneficial in the first week of the infant's life. Continuing longer than the first week, its effect is deleterious. It produces evident derangement of the digestive organs, and the infant that habitually nurses it never thrives. It has diarrhœa or vomiting, becomes more or less emaciated, and suffers from colicky pains. Sometimes an extreme degree of exhaustion is reached before the cause is suspected, for if the milk be pretty abundant the admixture of colostrum with it cannot be detected by the naked eye. The microscope alone reveals it. The following is an interesting example of this fact: In 1868 an infant six weeks old was brought to me with the following history: The mother had for several years been troubled with dyspeptic symptoms, but had otherwise been in good health. The infant at birth was fleshy and strong, but after the first week it had never thrived like other infants. It nursed regularly, and the quantity of milk was apparently sufficient, but it vomited as soon as it ceased nursing; it was much emaciated and the bowels were habitually constipated. The digestive organs of the infant had been in this unhealthy state, with little variation, from the first week, and it was very evident, from the emaciation and exhaustion, that it must soon perish unless some change were effected. The milk of the mother presented the usual appearance to the naked eye, but under the microscope colostrum-corpuscles were observed. A wet-nurse was immediately obtained, and from that moment the gastro-intestinal symptoms disappeared, with a rapid recovery. This case shows at once the evil effects of the colostrum and the need of a microscopic examination of the milk whenever the nursling suffers from indigestion.

HUMAN MILK.

Foster says that "milk is the result of the activity of certain protoplasmic cells forming the epithelium of the mammary gland. So far as we know, the fat is formed in the cell through a metabolism of the protoplasm. Microscopically, the fat can be seen to be gathered in the epithelium-cell in the same way as in a fat-cell of the adipose tissue, and to be discharged into the channels of the gland either by a breaking up of the cells or by a contractile extrusion very similar to that which takes place when an amœba ejects its digested food." Foster likewise states that there is also evidence that the casein and sugar are formed from the protoplasm in the mammary cells, and not by appropriation of the casein and sugar introduced into the system in the food. Therefore, if the food contain no fat, casein, or sugar, still these substances are produced by the cell-agency in the mammary gland (*Archiv für Phys.*, 1886, 539).

The specific gravity of human milk is about 1032. It has been carefully analyzed by different chemists with nearly the same result. The following table, prepared by MM. Vernois and Becquerel, gives the proportion of the various ingredients in 1000 parts:

Water	889.08
Sugar	43.64
Casein and extractive	39.24
Butter	26.66
Salts (ash)	1.38
	1000.00

Recently, Prof. Albert R. Leeds has analyzed forty-three sa
healthy human milk, with the following results:

	Average.	Minimum.	Maximum.
Specific gravity	1.0317	1.030	1.0353
Water	86.766	83.34	89.09
Total solids	13.234	10.91	16.66
Total solids not fat	9.221	6.57	12.09
Fat	4.013	2.11	6.89
Milk-sugar	6.997	5.40	7.92
Albuminoids	2.058	0.85	4.86
Ash	0.21	0.13	0.35

It is seen that the constituents of healthy human milk vary considerably in different women, especially the albuminoids, which are the nutritive part. Leeds found all the samples alkaline except one, which was neutral. The heat-producing constituents, the carbohydrates, fat, and sugar vary less than the albuminoids. Although human milk seems thinner than cow's milk, it nevertheless contains more solids and less water, and has a greater specific gravity. Milk-sugar is its largest solid constituent. Both the sugar and the fat are in greater proportion than in cow's milk, while the amount of albuminoids is much less. A very important difference between woman's milk and cow's milk is in the casein—not only in the quality, but quantity. The casein of cow's milk coagulates in large, firm masses, digested with difficulty by the infant, and its quantity is nearly five times greater than that in human milk, as we see by the following analysis of Prof. Leeds. Leeds found the average specific gravity of cow's milk 1029:

	Woman's Milk.			*Cow's Milk.*		
	Mean.	Minimum.	Maximum.	Mean.	Minimum.	Maximum.
Water	87.09	83.69	90.90	87.41	80.32	91.50
Total solids	12.91	9.10	16.31	12.59	8.50	19.68
Fat	3.90	1.71	7.60	3.66	1.15	7.09
Milk-sugar	6.04	4.11	7.80	4.92	3.20	5.67
Casein	0.63	0.18	1.90	3.01	1.17	7.40
Albumen	1.31	0.39	2.35	0.75	0.21	5.04
Albuminoids	1.94	0.57	4.25	3.76	1.38	12.44
Ash	0.49	0.14	?	0.70	0.50	0.87

Milk, being the sole food of early infancy, contains all the nutritive principles which are required for the growth and repair of the different tissues. Most of the salts which occur in the tissues exist primarily in the milk. Phosphate of lime, phosphate of magnesium, phosphate of the peroxide of iron, chloride of potassium, and chloride of sodium, known to exist in cow's milk, are believed to occur also in human milk. Epithelial cells are sometimes present, derived from the lining membrane of the lactiferous tubes.

MODIFICATION OF MILK IN CONSEQUENCE OF THE DIET.

The relative proportion of the different ingredients of the milk varies according to the diet. If the diet be poor, the amount of water increases and that of butter and casein diminishes. Lehmann says (*Phys. Chemistry*, vol. ii. p. 65): "From experiments made on bitches it would appear that a vegetable diet renders the milk richer in butter and sugar, while the solid constituents are augmented when a sufficient quantity of mixed food is given. Peligot found the milk of an ass most rich in casein when the animal had been fed on beet-root, while it was richest in butter when the food had consisted of oats and lucerne. Boussingault found the milk of a cow richer i casein when the animal had been fed on potatoes than when other fo taken. Reiset found that the milk of cows which were at grass w richer in butter than when the animals had stood all night in their out food; but Playfair found, on the contrary, that the quantity of butter in the milk increased during the night as much as during their stall-feeding, but that the quantity of butter in the milk was considerably diminished by the motion of the animals in the fields."[1] Simon made the following analysis of the milk of a poor woman. She was suddenly, during the period of lactation, deprived of the means of support, so that her food was insufficient in quantity and of poor quality. The amount of her milk was not diminished by privation, but the solid constituents were reduced to 86 parts in 1000. After this, for a time, her diet was nutritious and abundant, the quantity of milk was increased, and the solid constituents amounted to 119 parts in 1000. Her diet was again reduced, with a reduction of the solid elements to 98 in 1000, and at a later period the diet was again nutritious, with an increase of the solid elements to 126. The chief variation observed in the milk of this woman was in the amount of butter.

MODIFICATION OF MILK FROM ITS RETENTION IN THE BREAST.

M. Peligot has clearly demonstrated that the longer milk is retained in the breast the more watery it becomes. This is explained on the supposition that the solid portion is first absorbed. Therefore, the milk is richer the more frequently it is removed from the breast. A similar fact, which has the same explanation, has long been known—namely, that the first milk taken from the breast is thinnest, while that which flows last is richest. That first removed has remained longest in the gland, while that which comes last is but recently secreted.

A knowledge of this fact is of considerable practical importance. The milk, as M. Donné has shown, may be too rich, so as to cause indigestion, with more or less enteralgia, in the infant. Some nurslings, if the milk be too rich and abundant, reject a part of it by vomiting, but others do not, and suffer the consequence in derangement of the digestive organs. For such cases the remedy is to give the breast less frequently, by which a less amount of milk is taken and milk of a poorer quality. On the other hand, if there be poverty of the milk and the infant be insufficiently nourished, the milk is more nutritious if the nursing be at short intervals.

MODIFICATION OF MILK BY AGE AND BY MENTAL IMPRESSIONS.

The composition of milk varies also according to the age of the infant. Simon analyzed the milk of a woman at intervals for the period of about six months. In this case the amount of casein at first was small, but the quantity increased during the two months succeeding delivery, after which it was nearly stationary. A similar increase was observed in reference to the saline substances. The sugar, on the other hand, diminished in quantity as the infant grew older, its maximum amount being in the first and second months. The quantity of butter in the milk varies from day to day more than the other elements.

Many observations have been published which show that the composition of the milk may be materially changed by mental impressions. The infant has died suddenly in the act of nursing after his mother had been violently excited. Such a case is related by Tourtnal. The infant ceased nursing, gasped, and died in the mother's lap. In other cases convulsions have [illegible] urred. MM. Becquerel and Vernois made the chemical analysis of the [illegible] vous excitement, and found that the solid constituents were diminished to 31 parts in 1000, the most marked diminution being in the butter, which was only about 5 parts. In a case related by Parmentier and Deyeux the milk became watery and viscid, and remained so till the nervous attacks from which the patient suffered had ceased. Dairymen are well aware how ill-treatment and the separation of the calf from the cow diminish the milk which she yields. A new milkman seldom obtains as much milk as one with whom the cow is familiar. Bouchut, alluding to the influence of the moral affections on the secretion of milk, makes the following remark, the truth of which most mothers will acknowledge: "It is also a fact that the sight of the nursling, the idea of seeing it at the breast, and the joy which certain mothers thence experience, exercise a moral influence over the secretion of the milk entirely independent of their will. They feel the draught of milk as soon as they behold their child or think of it too deeply; and in a woman who saw her child fall to the ground the flow of milk ceased, and did not reappear until the child, having quite recovered, attempted to take the breast."

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[1] [illegible] ans., vol. ii. p. 55.

Rotch states that a primipara of an excitable and nervous temperament was in a marked degree anxious and despondent in reference to her infant, which she was wet-nursing. The infant began to suffer from indigestion, so that the mother's milk was analyzed with the following result: water, 89.17; fat, 0.62; sugar, 5.80; albuminoids, 4.21; ash, 0.20. This marked variation from normal milk was apparently due to the emotions of the mother. A wet-nurse was procured and the infant did well.

Modification of Milk by the Catamenial Function, Pregnancy, and Other Causes.

The catamenia reappear in most women before the close of lactation, often by the fifth or sixth month after delivery. If this function be re-established in the normal manner—that is, without any derangement of the system, without pain or undue profuseness—no unfavorable result ordinarily occurs with the infant. On the other hand, if the mother suffer any disturbance of the system or if the menses be profuse, the lacteal secretion may be so changed that the infant is injuriously affected by it. The symptoms produced are those of indigestion, such as abdominal pains, more or less vomiting, and diarrhœa. This result is, however, in my experience, quite exceptional. In rare instances more dangerous symptoms occur in the infant. A case has been reported to me in which at each catamenial period the nursling was seized with convulsions.

Charles Marchand found in three chemical analyses of the milk during menstruation a diminution of 2 to 4 parts in the butter, of 2 to 5 parts in the sugar, and a diminution in the casein and albumen of 2 to 5 parts. This seems but a trifling change when we recollect that human milk in the state of health contains, according to the analysis of M. Robin and others, 25 to 37 parts of butter, 37 to 49 parts of sugar, and 29 to 39 parts of casein in 1000 of milk. Rotch has made the following analyses of the milk of two women during the catamenia. Their infants exhibited symptoms of indigestion during, but not before or after, the catamenial flow:

	First Case.	Second Case.
Fat	0.62	1.37
Sugar	5.80	6.10
Albuminoids	4.21	2.78
Ash	.20	0.15
Solids	10.83	10.40
Water	89.17	89.60

(*Cyclop. of Diseases of Children*, 1889.)

In these two instances the albuminoids were increased. But even if the infant suffer from indigestion during the catamenial period, its duration is so short and the milk so soon returns to its normal state that the occurrence of the catamenia does not indicate the need of weaning if the infant be under the age of ten months. But if the menses reappear with regularity when the infant has attained the age of ten or twelve months, they should be considered as designed to supersede the secretion of milk, which, indeed, usually begins to diminish. Weaning is then proper. If the menses return early in the period of lactation and give rise to symptoms in the infant in consequence of the altered quality of the milk, it is best to allow but little nursing during the catamenia, and to employ artificial feeding instead until the flow of blood ceases.

The change produced in the milk by pregnancy is, in general, more injurious to the nursling than that caused by the reappearance of the menses. The milk of the pregnant woman frequently contains more or less of the viscid substance which characterizes colostrum. Still, the milk of pregnancy does not ordinarily derange the digestive function as much as colostrum in the first weeks of lactation, for pregnancy rarely occurs till after the infant is five or six months old, when the organs of digestion are less readily disturbed. The injurious effect of pregnancy on the infant is shown by vomiting or diarrhœa, by restlessness and occasional abdominal pains; in fine, by symptoms of indigestion. In many cases, however, these symptoms do not occur, and the infant, though nursing regularly, continues to thrive. No doubt, as a rule, the nursling should be weaned when there are clear evidences of pregnancy, but under certain circumstances weaning is injudicious. I have on different occasions been called to infants in midsummer dangerously sick with diarrhœal attacks induced by this cause. These infants were perhaps doing well or suffering but little from indigestion, when the mothers, suspecting themselves pregnant, at once withdrew them from the breast, and cholera infantum or a kindred disease was the result. No infant in the city should be weaned in the hot months. It is much safer, though there be indubitable signs of pregnancy, that it continue nursing till the cold weather. The better method is, however, under such circumstances to employ a wet-nurse or to remove the infant to the country and wean it there. In cold weather it is usually safe to wean an infant in the city after it has reached the age of five or six months.

Sometimes a young mother devotes herself unremittingly to the care of her infant, giving it the breast every hour or oftener through the day and frequently through the night. She gives the infant little rest, and has but little herself. This devotion, praiseworthy as it is, is nevertheless very injurious to both parties concerned. The rule should be repeated and remembered, that while an infant may nurse hourly during the first month, except in the hours which the mother requires for sleep, in which it should not nurse more than once or twice, after the first month nursing should be restricted to intervals of two hours till the third or fourth month, and in older infants, with greater capacity of the stomach, to intervals of three or four hours. Too frequent nursing produces indigestion with its usual fretfulness and diarrhœa, and it deprives the mother of the mental composure and rest which are required for successful lactation; but the more the infant frets, in many instances, the oftener the mother applies it to the breast, which only increases the indigestion. Worriment and lack of sleep tend not only to diminish the milk, but also to impair its quality.

Venereal excesses have a very injurious effect on the character of the milk. In our remarks on the hygienic treatment of the summer diarrhœa of infants we allude to authenticated cases in which excesses of this kind caused fatal intestinal catarrh in the nurslings. Again, the relative proportion of the ingredients in the milk may habitually vary from the normal without any assignable cause, so as to be injurious to the infant. Habitual ill-health, as from phthisis, anæmia, syphilis, or severe nervous disorder, sometimes so affects the secretion of milk as to render it unsuitable for the infant. It may cause a reappearance of the colostrum, like that immediately after parturition.

Effect of Medicines on the Mother's Milk.

This important subject has been investigated by Fehling (*Arch. f. Gyn.*, xxvii. p. 332; *Jour. de Méd.*, July 31, 1887). According to him, one to two grammes of salicylate of sodium, taken by a woman who is wet-nursing, may be in part recovered in the child's urine. Rheumatism in the nursing child may therefore be treated by the ordinary doses of this agent administered to the mother. Rheumatism occurs more frequently in the nursing infant than is commonly supposed, since its symptoms as regards the joints are usually mild and likely to be overlooked, and it often causes endocarditis and permanent valvular disease when its presence is not suspected and no physician is called. Schaeffer relates the case of an infant born with rheumatism. Iodide of potassium also, says Fehling, given to the mother, can be detected in large quantity in the infant's urine. We have Fehling's authority for the following statements: After applying iodoform to perineal lacerations, iodine was found in the milk and urine of the mother, but no apparent harm has resulted from applying iodoform to wounds or sores in the nursing mother. Mercury taken by the mother did not appear in the milk, and the same was true of acetic, hydrochloric, and citric acids. Therefore acid foods probably do not render the milk acid. Laudanum given by the mouth in no instance caused drowsiness in the infant, and morphia given hypodermically did not, as a rule, affect the child. On the other hand, atropine taken by the mother caused dilation of the infant's pupils. Hydrate of chloral taken by the mother did not affect the child. The effect on the nursing child of medicines administered to the mother needs further investigation. The observations relating to it published in the journals are as yet too meagre for the valid and reliable deductions which are required by the profession to ensure safe and proper medication of nursing women.

Differences in Women as regards Quantity and Quality of Milk.

There is a great difference in different women as regards the quantity and quality of their milk, and even the mode in which it is secreted. The best wet-nurses are usually robust without being corpulent. Their appetite is good, and their breasts are distended from the number and large size of the blood-vessels and milk-ducts. There is but a moderate amount of fat around the gland, and tortuous veins are observed passing over it. Such nurses do not experience a feeling of exhaustion and do not suffer from lactation.

The nutriment which they consume is equally expended in their own sustenance and the supply of milk. There are other good wet-nurses who have the physical conditions which I have described, but whose breasts are small. Still, the infant continues to nurse till it is satisfied, and it thrives. The milk is of good quality, and it appears to be secreted mainly during the period of wet-nursing. Other mothers evidently decline in health during the time of nursing. They furnish milk of good quality and in abundance, and their infants thrive, but it is at their own expense. They themselves say, and with truth, that what they eat goes to milk. They become thinner and paler, are perhaps troubled with palpitation, and are easily exhausted. They often find it necessary to wean before the end of the usual period of wet-nursing. There is another class whose health is habitually poor, but who furnish the usual quantity of milk without the exhaustion experienced by the class which I have just described. The milk of these women is of poor quality. It is abundant, but watery. Their infants are pallid, having soft and flabby fibre. All these kinds of wet-nurses are met in practice.

Occasionally, a considerable part of the milk is lost by oozing from the breast. This sometimes occurs in robust women, but is more frequently associated with weakness. It is then due to a relaxed state of the orifices of the milk-ducts. Galactorrhœa, as the excessive secretion and flow of milk are designated, is said to be often associated with a menorrhagic diathesis; that is, women whose menses have been profuse are apt to have too abundant a flow of milk, corresponding with the menorrhagia. It is said that galactorrhœa is also apt to occur in those who are subject to discharges from parts which sustain no immediate relation to the breast, as in cases of hemorrhoidal flux, diabetes insipidus, etc. Excitement or irritation of the uterus or ovaries may serve as an exciting cause of galactorrhœa in those predisposed to it, and excessive suckling may have the same effect.

Rules in regard to Suckling.

Newly-born infants should be applied to the breast about twelve times in twenty-four hours. The suckling should be mostly in the day-time, and only once or twice during the hours required by the mother for sleep. After the third or fourth week the infant should take the breast at intervals of two hours during the day-time, and only once during the seven or eight hours of sleep which the mother must have in order that her health be preserved and her milk be of good quality. A healthy infant empties the breast in ten to fifteen minutes of nursing, when it should be removed, and if in good condition it falls asleep, and may not awaken until the next suckling, or if it remain awake it is cheerful and contented. It is a fact not generally known by the laity that frequent nursing—as, for instance, every half hour—renders the milk too concentrated. It increases the solid constituents above the normal. On the other hand, if the infant be applied to the breast at long intervals, the proportion of solids in the milk is diminished below the average, and the water is in a corresponding degree increased. Knowledge of this fact has its practical application. A mother with a fretful infant, having indigestion, usually applies it often to the breast, and her milk in consequence becomes too concentrated and is digested with difficulty. In order that the ingredients in the milk be in the proper proportion for healthy digestion, not only should the mother lead a quiet life, with regular meals of plain but nutritious food, but suckling should be at intervals of about two or three hours.

Scantiness of Milk: its Causes and Treatment.

Though the amount of breast-milk which the infant requires is less than was estimated by Cumming, still insufficiency of this secretion is not uncommon, especially in cities. According to the statistics of Drs. Merei and Whitehead, among healthy mothers there is insufficiency in 16.5 per cent., while among mothers in feeble health the percentage is 46.6. In treating of this subject in the following pages reference is not had to those cases in which there is temporary diminution of milk from acute diseases or other perturbating causes, but to those cases in which there is habitual scantiness.

One cause of scanty secretion of milk is a life of privation or of daily work, which necessitates separation from the infant. Insufficient food may render the milk more watery, as has already been stated, or it may cause diminution in its quantity. The mother thus situated is pallid. She is subject to palpitation and attacks of faintness. Her condition, indeed, is that of anæmia. Working women have scantiness of milk, not only in consequence of hardships, but also because they are usually separated for hours from their infants. Age is also a cause of scantiness of milk. Mothers at the age of forty years ordinarily furnish less milk than between twenty and thirty. Those who have not borne children till late in life, and whose mammary glands have therefore long been inactive, have less milk than those who commence bearing children at the usual period.

Routh speaks of hyperæmia as a cause of defective lactation. "This is a variety," says he, "which I have chiefly observed among hired wet-nurses selected from the poorer classes and admitted into wealthier families. . . . . When feeding at the expense of a master or mistress the amount they devour often surpasses all moderate imagination. They, in fact, gormandize. If in such instances a wet-nurse be given all she asks for, she will be found often to eat quite as much as any two men with large appetites; and as a result she becomes gross, turgid, often covered with blotches or pimples, and generally too plethoric to fulfil the duties of her position. The plethora, as first induced, is of the sthenic variety, but it soon assumes an asthenic character, and as the immediate result the breast no longer secretes its quantity of milk. There may be good milk secreted, but it is in small quantity, and this quantity diminishes daily. The breast may also enlarge, but it is from a deposition of fatty tissue in and about it, as in other parts of the body. The veins on the surface become less apparent—always a bad feature in a suckling breast—till finally the flow of milk ceases altogether."

Atrophy of the breast from the employment of iodine or from long disuse is also a cause of insufficiency of milk.

It is so necessary for the health and development of the infant that the milk should be in proper quantity as well as quality that it is best in a work of this kind to consider the treatment of insufficient secretion, and, on the other hand, of excessive secretion and loss of milk, or galactorrhœa; and first of insufficient or scanty secretion.

The most efficient mode of increasing the lacteal secretion is that which is also natural—namely, suction from the nipple. There are many cases on record in which this has produced the flow of milk in women who have never borne children, and even in men. Baudelocque mentions the case of a girl eight years old who suckled her brother for a month, and cases at the opposite extreme of life have been reported—one of a woman of seventy years who wet-nursed a grandchild twenty years after her last confinement.

The following case, which was under my observation, is interesting in this connection: Lizzie S—— was confined with her first child on May 30, 1876. When the baby was a few days old, and before she had left the bed, she had inflammatory symptoms which proved to be due to pelvic cellulitis. Its course was tedious; her milk diminished, and its secretion soon ceased. On or about the first of August she began to sit up, and on August 11th she was admitted into the Sixty-first street branch of the Infant Asylum, pale and wasted, but with returning appetite. She had no mammary secretion for eleven weeks, and her breasts were small and flabby. She had two fistulous openings, one vaginal and the other low down in the back, near the lower end of the sacrum or the coccyx. The baby was in a fair condition, having been wet-nursed by other women. Experiences in this and other institutions show that infants having breast-milk do far better and are much more likely to live than those without breast-milk, and the mother was therefore advised by one of the managers—himself a physician—to suckle her baby, although there was not a drop of milk in her breast and nursing had been suspended eleven weeks. To the surprise of the mother and of the nurses in the house—to whom the procedure seemed very ridiculous—milk began to appear in a few days. The mother left the institution October 8th, but before her departure she was able to furnish perhaps two-thirds the quantity of milk which her infant required. This case affords practical illustration of the fact that frequent suckling is the most efficient galactagogue. Mothers sometimes, having little breast-milk, suckle their babies at long intervals, and finally, discouraged at the unproductive state of their breasts, resort to weaning, when by patience and more frequent use of their breasts they might become good wet-nurses. In the cities and during the summer season, in which breast-milk is so much required, the history of cases like the above, and the more remarkable cases in which men and grandparents have had secretion of milk and have suckled infants, should induce the physician to withhold his consent to premature weaning, which the disheartened mother is apt to suggest, unless indeed he perceives other reasons for weaning apart from scantiness of milk.

Travellers among barbarous nations or tribes have often observed these cases of unnatural lactation. Humboldt saw a man thirty-two years old who gave the breast to his child for five months, and Captain Franklin in the Arctic regions met a similar case. Dr. Livingstone in his African travels says that he has examined several cases in which a grandchild has been suckled by a grandmother, and equally remarkable instances of wet-nursing occur among the negroes of the Southern and Middle States. Professor Hall presented to his class in Baltimore a male negro, fifty-five years old, who wet-nursed all the children of his mistress. In these cases of abnormal lactation, so far as we have accurate records of them, it is ascertained that the breasts were torpid, and even sometimes, as in old people, atrophied, till the nursing commenced. Titillation or pressing of the nipple caused an afflux of blood to the gland and developed its functional activity, so that milk was produced for the sustenance of the nursling. Therefore, in case of scanty secretion of milk the mother may increase the quantity by applying the infant often to the breast. If, dissatisfied with the small amount of nutriment which it receives, it refuse to make the necessary suction, any other mode of gentle traction or pressure may be employed in addition. The occasional employment of another infant or a pup, milking the breast with the thumb and fingers, or the gentle suction of a breast-pump, aids in stimulating the secretion. Forcible rubbing or traction of the breast defeats the purpose for which it is employed. It produces too much irritation and tenderness. The best mode of stimulation is by nursing, as it is the natural mode, and the effect of the infant at the breast upon the maternal instincts aids in promoting the secretion.

Another mode of increasing the functional activity of the mammary glands is by the electrical current. The fact is established by physiological experiments that glandular organs can be made to secrete more actively by the stimulus of electricity, and, accordingly, this agent has been successfully employed to promote the secretion of milk. In Routh's *Infant Feeding* several cases are related which show the beneficial effects of this agent (page 149 *et seq.*). Among them are six reported by Dr. Skinner of Liverpool. In all these one or two applications of the electrical current sufficed to restore the secretion. The following is Dr. Skinner's mode of employing this treatment:

"1. *Direct.*—Both poles must terminate in cylinders, with sponges well moistened in tepid water. The positive pole is pressed deep into the axilla, *while the negative is lightly applied to* the nipple and the areola, the current being no stronger than is agreeable to the patient's feelings. The poles are kept in this position for about two minutes.

"2. *Intramammary.*—The poles are to be, as it were, imbedded in the mamma and moved about, raising and depressing both poles at once in and around the organ for the space of another two minutes. The same is to be done to both breasts daily until the secretion is properly established. Hitherto one or two sittings have always sufficed in my hands" (*Communication of Dr. Skinner to Dr. Routh*).

In all cases of scanty secretion of milk the regimen of the mother is a matter of importance. Personal and domiciliary cleanliness is essential for successful wet-nursing. A certain amount of exercise in the open air is conducive to the health of the mother and to the secretion of abundant and healthy milk. A case is related to show the effect of fresh air and out-door exercise on the lacteal secretion. A lady of cleanly habits, living in London, had a very scanty supply of milk. She removed to the pure air of the seashore, and immediately the quantity became abundant and continued so for months. Such cases are not infrequent. A mode of life that contributes to the general health of the mother will not fail to augment the quantity of her milk if it be scanty, and to improve its quality.

Much has been written in reference to the diet of women who suckle. It is a popular belief that certain articles of food promote the secretion of milk much more than other articles, though equally nutritious. No doubt writers have erred in recommending exclusively this or that kind of food as most likely to produce milk. The exact kind of food which is preferable in a certain case depends partly on the physique of the individual and partly on the character of the food to which she has been accustomed. A mixed diet contributes most to the sustenance of the mother and to an abundant secretion of milk. Animal substances which furnish a due supply of nitrogenous aliment should be given with the farinaceous. Mothers pallid and inclining to an anæmic condition require a larger proportion of animal diet than those in good general health. On the other hand, plethoric women, such as Routh describes, who with excellent appetite consume large quantities of food, and who become more and more full-blooded and corpulent while the milk diminishes, require a more restricted animal diet in connection with more exercise, especially in the open air.

There are certain kinds of food which do appear to have a galactagogue effect with most wet-nurses. Oatmeal gruel is one of these. Wet-nurses often remark, after taking a bowl of this, that they feel the flow of milk. Cow's milk with some has a similar effect. Porter or ale, taken once or twice a day, also promotes the secretion of milk, especially in those who have poor appetite and whose systems are somewhat reduced.

A great variety of medicines have been used for their supposed galactagogue effect. Medicines which improve the general health are no doubt sometimes useful for this purpose, such as the vegetable and ferruginous tonics and, perhaps, cod-liver oil. But there are other medicines which it is claimed have a specific effect on the mammary gland, promoting its secretion. Lettuce, wintergreen, fennel, the broom tops (scoparius), and marshmallow have been used for this purpose. There can be no doubt that the aromatic stimulants, as fennel, anise, and carraway seed, given in soups, sometimes stimulate the lacteal secretion. Another medicine which has been recommended to the profession as a galactagogue is castor oil and the plant from which it is derived.

CHAPTER V.

SELECTION OF A WET-NURSE.

In the cities cases are frequent in which mothers, with all possible care or endeavor, find themselves unable to suckle their infants. Their health is too poor or the milk possesses the properties of colostrum, or it is no longer secreted on account of nervous excitement or exhaustion or inflammation of the breasts. The number of such cases in the city would surprise physicians who are familiar only with the healthy and robust mothers of the country. The infant thus deprived of the mother's milk should, if practicable, be furnished with a wet-nurse.

The selection of a wet-nurse often devolves upon the physician, and is a duty of great responsibility. It is better to select one between the ages of twenty and thirty years, and one who has suckled an infant previously. A wet-nurse between the ages of twenty and thirty is usually more active, cheerful, and conciliatory than one of a more advanced age, and her milk is more apt to be abundant and nutritious. Those who have previously suckled and had charge of infants are obviously more competent to serve as wet-nurse than are primiparæ. The milk of a wet-nurse whose infant is under the age of six months will ordinarily agree with a new-born infant. If above that age it sometimes agrees, but often does not.

The most difficult and responsible task imposed on the physician in the selection of a nurse is to ascertain the exact condition of her health and the quantity and quality of her milk. Constitutional syphilis is common in the class of women who present themselves for wet-nursing; it is often latent or its symptoms are easily concealed, and it is communicable by lactation. The virus may be received by the infant from fissures or excoriations of the nipple. The nursling tainted by syphilis may, on the other hand, communicate the disease to the nurse through the same source. It is not fully ascertained whether the syphilitic virus may be conveyed to the infant by the milk. But the cases which have accumulated in the records of medicine are numerous in which infants born of healthy parents have contracted syphilis from the breasts of diseased nurses (see article Syphilis). These infants have sometimes led a short and miserable existence, and have occasionally increased the misery of the household by imparting the disease to others. The duty is therefore imperative on the part of the physician to examine carefully the wet-nurse in reference to any evidences of the syphilitic taint. Acquainted with the symptoms of syphilis, he may usually, by shrewd questioning and by careful examination of the present appearance and condition of the woman, ascertain with considerable certainty whether her system has ever been infected. References should also be obtained and consulted, and, if practicable, the physician who has attended her be communicated with.

It is safer to employ a wet-nurse two months after her confinement than previously, for if she have the syphilitic taint it will by this time show itself in the innutrition, coryza, and anal sores of her infant.

There are also, among the women who present themselves for wet-nursing in the cities, many of a scrofulous habit and many who possess an hereditary tendency to tuberculosis, if indeed they do not already have the incipient disease. Such applicants should be rejected on account of the poverty of their milk and the probability that they will not be able to endure the debilitating effect of wet-nursing.

The milk should be examined in order to ascerta
tity and whether it contain colostrum. If there be

day, it is probable that there is some fault in the health or digestion of the wet-nurse, and that her milk may disagree with the infant. It is not necessary that the breast should be large in order to furnish a sufficient quantity of milk, since, as has been already stated, in some the secretory function is active during the time of each nursing, so that, although the breasts are of moderate size, a sufficient amount of milk is furnished. The nipples should be well formed and prominent, and preference should be given to those wet-nurses in whom blood-vessels are seen ramifying over the breasts.

By examination of the milk its degree of richness can be readily ascertained. A quantity of it should be placed in a test-tube, and the cream which rises to the top indicates, approximately, the character of the milk. Good milk furnishes 3 per cent. of cream, and the casein and sugar usually correspond in quantity with the cream. An instrument has been invented, called the lactometer, by which the exact amount of the cream can be ascertained. It is simply a tube graded into one hundred divisions. It is placed upright and filled with milk, and the number of divisions occupied by the cream indicates its proportion in one hundred parts. The lactoscope is another instrument employed for the purpose of ascertaining the richness of the milk. It consists of two concentric tubes which move upon each other. Milk which we wish to examine is poured within the tubes sufficient to obscure a light viewed through it three feet distant. The column of milk is then diminished till the light begins to be visible. The size of the column indicates the degree of opacity and the richness. The lactoscope was invented by M. Donné, and is described by him.

Dr. Minchin recommends a simple mode of determining the richness of cow's milk, and it would equally answer for the breast-milk. A vessel holding about one ounce, and containing a graduated enamel slab passing diagonally from above downward, is filled with milk. It is then covered with a glass slide carried over it in such a way as to exclude bubbles. The number of degrees which can be read indicates the character of the milk as regards its richness.

Examination of the milk by the microscope not only enables us to determine whether there are abnormal corpuscles or granular elements, but also its richness. It should be examined before the cream has separated. Oil-globules of small size and few indicate poverty of the milk; very large oil-globules are said to indicate milk which is apt to be indigestible, especially in feeble infants. Such are the free globules of the colostrum. Numerous oil-globules of medium size indicate nutritious milk. In examining the milk by the microscope or otherwise in order to determine its richness, the important fact should be borne in mind that milk removed from the breast at short intervals is richer or more concentrated than that removed at long intervals, as we have stated elsewhere. A larger percentage of water is present if the interval be four hours than if it be two hours. Another important fact which should be borne in mind in testing the milk is that that first drawn from the breast is more watery, or not so rich, as that last removed or the stripping, as is seen by the following analysis, made by Harrington and published by Rotch in his interesting paper on infant feeding in the *Cyclopædia of Diseases of Children*:

	Fat.	Total Solids.	Water.	Ash.
Fore milk	3.88	13.34	86.66	0.85
Middle milk	6.74	15.40	84.60	0.81
Strippings	8.12	17.13	82.87	0.82

The increase in the solid constituents of the milk near the close of a nursing is said to be chiefly of fat, but partly of the albuminoids. It is evident, therefore, that the milk obtained from a breast that is emptied at short intervals is richer than that obtained when the breast is drawn at long intervals.

Rotch publishes the following analysis made by Harrington, in which this fact is clearly shown:

	Milk drawn at two hours' interval.	Milk drawn at twelve hours' interval.
Total solids	15.32	10.14
Water	84.68	89.86
	100.00	100.00

Vogel in 1850 made the discovery of vibriones in human milk. The fact is established that these animalcules may be generated in the milk within the breast, though such cases are not frequent. Dr. Gibb describes a case which he met (*Ranking's Abstract*, vol. xxxiv.): An infant seven weeks old, wet-nursed by its mother, who had the appearance of perfect health, was, nevertheless, ill-nourished and emaciated. It had no diarrhœa or other apparent disease, and the milk was therefore examined. Vibriones were discovered in the milk immediately after it was obtained from the breast. The milk had the usual amount of cream, and seemed to the naked eye of good quality. According to Dr. Gibb, two genera of microscopic organisms occur in the milk—namely, vibriones and monads. It is believed that the monads occur in consequence of fermentation of the sugar and the production of lactic acid. Vogel also attributed the production of the vibriones to fermentation occurring in consequence of heat and congestion of the breast connected with sexual excitement. This explanation is probably not correct, because vibriones sometimes occur when there is no unusual heat of breast and no evidence of fermentation. The fact that such organisms may be found in milk which seems of good quality to the naked eye affords additional proof of the usefulness of the microscope in selection of a wet-nurse.

Many wet-nurses have a return of the menses as early as the fourth or fifth month after delivery. The re-establishment of this function in some women impairs the quality of the milk, so as to render it less nutritious, and perhaps less digestible, during the time of the catamenial flow, as we have stated in a preceding paragraph. In the selection of a wet-nurse, then, preference should be given to one who does not have the periodical sickness; but if she be already employed and give satisfaction, the reappearance of the catamenia does not indicate the need of the change of nurse, unless the digestion of the infant be disordered or its nutrition be impaired.

In the selection of a wet-nurse attention should also be given to her mental and moral traits. Cheerfulness, affection, veracity, and a proper appreciation of the responsibility of her situation enhance greatly the value of a wet-nurse. Not less important are habits of temperance and cleanliness. I could cite cases of the most melancholy results from the absence of these traits. In one case idiocy resulted from an infant falling upon the pavement from the arms of a reckless or intemperate wet-nurse.

In most cases the mode of examination indicated above suffices to show the character of a wet-nurse, so far as her health and milk are concerned. It should be borne in mind, however, that the microscope does not always reveal deleterious properties in the milk. Elements which are in a state of solution, and are invisible, may occur in excess, so as to impai [illegible]
of the milk and render it indigestible. The following cas [illegible]
saline ingredients seem to have been in excess, is related [illegible]
(*British and Foreign Medical Review*, vol. xii.): "An inf [illegible]
was in good health and had borne several children exhibite [illegible]

ance for the first five weeks after birth. The alvine evacuations then became copious, fluid, and discolored, and the child lost flesh and strength. After the usual remedies had been vainly administered for a fortnight, the mother remarked that the child did not take the right breast willingly, and so much did the unwillingness increase that at length the mere application of the nipple to the child's lips occasioned loud crying. On examination it was found that the milk of the right breast had a distinctly saline taste, whereas the milk of the opposite breast was of the ordinary sweetness; no difference of consistence or color was discoverable. From that time the child was only allowed to nurse the left breast, and in a few days all diarrhœa and sickliness of appearance vanished." In this case there was no appreciable disease of the breast, although its secretion was perverted. The deleterious character of the milk was discovered, not by any change in its appearance, but by the taste.

It is obviously very necessary, before recommending a wet-nurse, to ascertain whether she will probably furnish sufficient milk; for, however excellent she may otherwise be, if she do not satisfy the wants of the infant she obviously should not be employed. If the infant of the nurse be well nourished, and if it seem satisfied after nursing ten or fifteen minutes, she probably has sufficient milk. The more exact method of weighing the infant before and after it nurses, and observing whether the difference corresponds with that given in Chapter VII., enables us to determine more accurately the capabilities of the wet-nurse.

CHAPTER VI.

COURSE OF WET-NURSING—WEANING.

After the birth of the infant the mother needs rest a few hours—four or five or a little longer in tedious and exhaustive cases—and then it should be applied to the breast. There is frequently a little milk at this time, and the act of nursing promotes the secretion and increases the quantity. The full secretion is not, however, established before the third day, and, though the infant be applied to the breast often, it obtains but little milk. Infants are so constituted that they require but little food until it is naturally provided for them, and the common practice of feeding them to repletion with various sweetened mixtures almost as soon as life begins, because they obtain little breast-milk, is to be deprecated. Filling their stomachs in this way has a tendency to prevent their drawing upon the nipples with the avidity which is required to stimulate a free flow of milk. Besides, as I have many times observed, indigestion, diarrhœa, and sprue are common results of this injudicious feeding. If, therefore, the infant be applied to the breast every second hour when the mother is awake till the third day, and be fed nothing besides, there need be no anxiety as regards its nutrition. If on the third day the breasts do not begin to fill and the secretion be delayed, a little fresh cow's milk, diluted with double its quantity of warm water, and slightly sweetened, should be given every fourth hour, but should be withheld as soon as the flow of milk occurs.

Infants under the age of one month should nurse about every hour and a half by day and at longer intervals by night, or about twelve times in twenty-four hours, for the stomach of the new-born holds but little, and therefore receives but little at each nursing, and its digestion is active. The interval should be longer at night than in the day-time, so as to allow the mother more sleep. In the second month the interval should be about two hours, and it should be gradually lengthened as the age increases, so that after the fourth month nursing should be about every third hour, and after the sixth month, when the use of some artificial food is proper, every fourth hour.

The infant should be habituated to nursing at regular intervals, and when it is it will ordinarily awaken at about the proper time. The practice on the part of the mother of applying the babe to the breast whenever it frets and as a means of quieting it, although it have but just nursed, is pernicious and should be forbidden. Giving the stomach no time to rest or filling it to repletion tends to produce indigestion and diarrhœa and to increase its fretfulness. The cause of the fretfulness should be sought for, that the proper measures may be applied. In ignorance of the cause it is better to quiet restlessness by carrying the child, or even by rocking it, than to increase the task of the digestive function. Fretfulness of infants is often due to colic or griping produced by irritating products of imperfect digestion in the intestines, and the addition of more food has a tendency to increase rather than to diminish it.

While regularity in nursing is required, still, as M. Donné has said, mathematical exactness in this matter would be ridiculous. Quiet natural sleep of a well-nourished infant should not be interrupted in order to give it the breast, unless the sleep be unusually protracted. It will usually awaken when the system requires more nutriment. Ill-nourished infants often sleep but little, making known their want by crying and fretfulness, until they become wasted and prostrated, when they are drowsy in consequence of passive congestion of the brain. This drowsiness is evidently a pathological symptom. It shows the need of increased nutrition. It is due to scantiness of milk or milk of poor quality, and the infant should be aroused frequently for the purpose of giving it nutriment or even stimulants. The breast-milk is sufficient for its nutrition till the age of six or eight months, provided that it is abundant and of good quality. Therefore, if the mother be strong and experience no exhaustion, no other nutriment need be given till that age.

Many mothers, however, by the third or fourth month of wet-nursing find that they have not sufficient milk to meet the wants of the infant. The constant drain upon their systems sensibly impairs their health. In such cases it is proper to commence with a little feeding from the spoon or bottle, and increase the quantity given as the infant grows older. Great care is, however, requisite in the preparation of food for so young an infant, whose digestive organs are still feeble and easily deranged. In the country, where diarrhœal affections and the so-called gastric derangements are not frequent, the danger from artificial feeding is less than in the city, and in the cool months in the city the danger is less than in the summer season. Infants of the city between the months of May and October have a strong predisposition to diarrhœal attacks, the result of antihygienic influences which surround them. Errors of diet in their case readily provoke disease or derangement of the digestive organs, often of a severe and dangerous form. Moreover, experience has shown that artificial feeding during the period when nature designed that they should be nourished at the breast very commonly produces in the hot months more or less vomiting and diarrhœa, followed by emaciation and other evidences of malnutrition. Therefore an exception must be made in case of the city infant as regards the commencement of artifici feeding. If it be under the age of one year, it should be nourished e *sively, or almost exclusively, at the breast* during the hot months wh ticable, even if the mother suffer somewhat in her health from the constant drain upon her system. It should, however, receive the amount of nutriment which it requires, and, if there be not sufficient breast-milk, it will be necessary to supply the deficiency by artificial feeding. The reader is referred to Chapter VIII. for facts relating to the subject of artificial feeding.

Weaning ought to take place, as a rule, between the ages of ten and twelve months. It is well, if the mother's health be good and her milk sufficient, to defer weaning till the canine teeth appear. The infant, then possessing sixteen teeth, is able to masticate the softer kinds of solid food. Weaning should be gradual. Mothers often speak of weaning on a certain day. They have given but little artificial food and have suckled at regular intervals, till at a fixed time they have denied the breast altogether. This abrupt change of diet should be discouraged. It should only be recommended under peculiar circumstances. It is apt to derange the digestive organs, and it causes fretfulness and sleeplessness on the part of the infant for a week or more. Weaning should commence by feeding with a spoon a little oftener through the day, and nursing less, and by discontinuing the practice of suckling at night. The infant tolerates this gradual change of diet, while it rebels against sudden weaning, and by its fretfulness increases greatly the care and trouble of the mother. Nurslings in the city should not be weaned in warm weather nor within a month immediately preceding it. If the mother's health fail or her milk become deficient in the summer months, so that she cannot continue suckling, a wet-nurse should be employed, or the infant should be sent to some rural locality and weaned there. Weaning in the city in hot weather should, if practicable, be avoided on account of the liability to the summer diarrhœa produced by change of diet, although I believe there is less danger from this than formerly, since we now understand better how to feed infants.

CHAPTER VII.

QUANTITY OF FOOD REQUIRED IN INFANCY AND CHILDHOOD.

INFANTILE FEEDING.

Over-feeding.—Nearly half a century has elapsed since the most distinguished New England physician of his day, Dr. James Jackson of Boston, wrote in his *Letters to a Young Physician* that a certain ailment of the digestive system of infants had often puzzled him when a young practitioner. It was characterized by the occurrence of green and unhealthy stools, showing imperfect digestion. The stools contained an unusual amount of mucus, and were passed more frequently than the normal stools of a healthy infant. After observing many infants thus affected, and ascertaining the manner and frequency of their feeding, the truth gradually dawned upon him that their unhealthy evacuations were due to over-feeding. By diminishing the amount of nutriment given and lengthening the intervals between the feedings, these infants were soon cured.

Suction by the lips of the infant seems to be to a great extent automatic, so that if its mother or wet-nurse have a copious supply of milk, it is liable to over-nurse, or, if it be bottle-fed, is liable to take more from the bottle than it requires for its nutrition. Some infants if over-fed regurgitate the surplus food, but others do not, and the portion which is not digested undergoes fermentation and acts as an irritant to the stomach and intestines. Acids, as the butyric and lactic, and gases which distend the stomach and intestines and cause colicky pains, form from the fermentation. An infant thus suffering from overtaxed digestion, and from the presence of irritating acids and gases in the stomach and intestines, is usually fretful and its sleep is disturbed and broken. The cause of its restlessness is often misunderstood by the mother, who thinks it may be due to insufficient nutriment, and accordingly it is applied more frequently to the breast, or, if it be bottle-fed, it is given the bottle more frequently. I have seen not a few over-fed infants who on account of their fretfulness were applied to the breast at intervals of a few minutes, so that the health of their mothers was impaired by the lack of sleep and the drain upon their systems; and the infants, on account of too frequent nursing, suffered indigestion, and occasionally from gastro-intestinal catarrh. Moreover, milk drawn too frequently from the breast usually contains an excess of the solids, so that it is digested with more difficulty than when it is drawn at the proper intervals, as I have elsewhere stated. For this reason also too frequent application of infants to the breast is likely to cause indigestion and gastro-intestinal derangements.

Cases might be related to substantiate these statements. Thus in December last I attended an infant of four months that had been very fretful and with insufficient sleep for weeks. The wet-nurse who had charge of it had apparently the proper requisites, such as health, youth, robustness, and well-developed breasts, which seemed to furnish sufficient milk and of good quality. But the infant, though fairly nourished, had so little sleep and was so fretful, crying so much during the night as well as day, that the whole household was deprived of the needed rest. The nature of the baby's ailment was soon detected, for its stools presented appearances indicative of indigestion and intestinal catarrh. They contained numerous rounded, whitish masses, apparently of casein mixed with mucus and thin fecal matter. Pepsin preparations with bismuth were at first employed, without any marked result, but improvement began at once when the infant, instead of being frequently applied to the breast, as had been the practice, was allowed to take it only every third hour, and was fed nothing in the interval. It had been over-fed, and the remedy more effectual than the medicines employed was the simple one of its less frequent application to the breast. Over-feeding is, I think, more common with bottle-fed infants than with those nourished at the breast.

Insufficient Nutriment.—On the other hand, infants, both wet-nursed and bottle-fed, frequently do not obtain sufficient nutriment. In families of the city poor nursing mothers often have scanty diet and are overworked, and the milk which they furnish to their nurslings under such circumstances is liable to be watery and insufficient. Sometimes infants, when they have reached an age at which the breast-milk is inadequate and additional food is urgently needed, are nevertheless denied this by their mothers. Even mothers who are apparently robust and give the breast at proper intervals, often have insufficient milk, so that their infants do not thrive, and they are ignorant of the cause. MM. Vernois and Becquerel, on careful examination of 89 infants wet-nursed by women apparently in good health, ascertained that 15 were insufficiently nourished. An infant that obtains sufficient breast-milk draws the breast quietly and continuously twelve or fifteen minutes, when it releases its hold of the nipple and probably falls into a quiet sleep, having a satisfied aspect. If the breast-milk is scanty and insufficient, the baby is fretful when it nurses, frequently lets go of the nipple, and does not *have the quiet sleep of the satisfied* infant. If its mouth be inspected when it is nursing, it will be found to contain but little milk. But if the supply of breast-milk be abundant, it will appear in quantity between the lips and in the mouth of the infant during the nursing.

Again, many bottle-fed infants are allowed sufficient food, but it is not adapted to their age, and is digested with difficulty, so that the nutriment which they derive from it is insufficient. Much has been said and written upon the practice common in tenement-houses of giving farinaceous food to infants under the age of three months, when the saliva, which is the chief agent that digests starch, is scanty and insufficient for its digestion. In the feeding of older children in families of the laboring class we know how frequently food is employed that is unsuitable to the age—that acts as an irritant to the stomach and intestines, producing attacks of vomiting and diarrhœa. The portion of such food that is digested and which serves for nutrition is insufficient, while the undigested part acts as an irritant. Infants that receive such unsuitable diet really suffer from lack of food, although its bulk may be sufficient. They are hungry from the lack of proper nutriment, and are consequently fretful. They digest and assimilate so small a part of this unsuitable diet that they lose flesh and have the usual symptoms of innutrition.

It is evident from this survey of what actually occurs in the feeding of infants that while it is of the utmost importance that food should be of the proper kind according to the age and properly prepared, it is also equally necessary for their successful alimentation that they be fed at proper intervals and with the proper amount of food. Certain physicians, appreciating the importance of a correct knowledge of the amount of food required by infants, have made careful observations in order to ascertain it. M. Parrot (*L'Athropsie*, Paris, 1877) weighed infants before and after each feeding with cow's milk. The number of feedings was six in twenty-four hours. His observations were scarcely sufficient in number for accurate deductions, but he concluded from them that the quantity of cow's milk required in twenty-four hours is as follows: 9½ ounces for the first month, 19 ounces for the second, third, fourth, and fifth months, and 25 ounces for the sixth month. This estimate is for pure cow's milk, used without dilution. The use of milk in its pure state and undiluted he considers preferable to that of diluted milk. After the sixth month he thinks that 4½ to 6½ ounces for each month should be added to the quantity previously employed. Meigs and Pepper mention the case of an infant of four months that took 36 ounces of breast-milk daily, and another of five to six weeks that took 18 to 23 ounces. The same authors cite the observations of M. Bouchard, who concludes, from weighing infants, that while the newly-born require much less breast-milk than those who are older, 20 ounces daily are needed between the ages of one and three months, 23 ounces after the third month, 27 ounces after the fourth month, and 30 ounces between the ages of six and nine months.

Dr. Ssnitkin of St. Petersburg some time since prepared a formula for determining the quantity of food required by young infants which he believes is a safe and reliable guide. In his opinion the greater the weight of the infant the greater is the capacity of its stomach and the greater is the amount of food required. If this rule be invariably true, or true in a large majority of instances, the difficult problem of determining how much to feed infants each time or each day would have a comparatively easy solution, for by weighing the infant we could readily determine how much food it requires. Since the formula devised for infant-feeding by Dr. Seibert, and presented to the consideration of the profession in this country, is also based upon differences in the weight of infants, and not upon differences in their ages, I will briefly relate facts which in my opinion show the impropriety and incorrectness of this method. Is it a fact that the heaviest animals of a species uniformly require the most food? Is not the amount of food required determined to a considerable extent by the activity of the animal and the amount of molecular disintegration consequent on exercise? Take two infants of the same age. One may lead a sluggish life, being most of the time asleep. It has a superabundance of fat and weighs heavily. The other is more hours awake and its limbs are more active. It probably weighs one or two pounds less than the other infant, as it has less fat and more frequent evacuations. Does not the latter infant require as much food as the former? A rachitic child with big head and joints and pendulous abdomen may weigh a pound more than a healthy child of the same age. Does he in consequence require more food? A large proportion of the infants remaining in the city during the summer months either lose or do not gain in weight. They weigh no more, and often less, at the close of September than at the beginning of June. Shall we give them the same amount of food, or even less, at the end of September, when their appetite begins to return, than they were allowed on the first of June, because they weigh the same or less? Infants that have had any sickness except the mildest lose in weight: must we diminish the quantity of their food so that it will correspond with the loss of weight? In the New York tenement-houses a large proportion of the infants, even those without any marked ailment, weigh less than they should on account of their improper feeding. Must we under such circumstances give them at each feeding an amount of food corresponding with their weight? Let me illustrate by a case. A physician in large practice requested me to examine an infant that was puny and delicate and had ceased growing. It probably did not have more than three-fourths of the ordinary weight of infants of the same age. When the question was asked how the infant was fed, the physician replied before the family, with an air of assurance, that he had given explicit directions that the baby should be fed with one teaspoonful of condensed milk to a gobletful of water; and this had been the diet for a considerable time. It had abundant urination with uniformly constipated bowels. I am sure that neither Dr. Ssnitkin nor Dr. Seibert, had he been in my place, would have put this diminutive and ill-used infant in the scales in order to determine how much food to give it. I cite these instances not to throw discredit on the praiseworthy investigations of Drs. Ssnitkin and Seibert, but in order that I may ask them if in formulating rules for the feeding of infants it is not necessary to regard other circumstances besides the weight, especially the age. We know that improvements in the care and treatment of children, especially such improvements as require mechanical appliances, are seldom perfected at once, but after many changes which experience suggests. Witness, for example, intubation. Many observations by different observers and under different circumstances are required, in my opinion, in order to obtain the data for formulating rules for the feeding of infants which will require no change.

A few years since Drs. Chadbourne, Parker, and myself made observations in the New York Infant Asylum and New York Foundling Asylum in order to determine how much food children require at different ages. Those selected for observation were well nourished, and they were accurately weighed before and after each nursing or feeding. Eleven infants under the age of three weeks, who took the breast, with three exceptions, twelve times in the twenty-four hours, were found to take in the average 12.55 ounces of the breast-milk in the day and night, as is seen by the following table:

Table I.—*Newly-born Infants (those under the Age of Three Weeks).*

No.	Name.	Age.	Number of nursings.	Milk nursed in 24 hours.		
				Quantity in weight.		Quantity in fluidounces.
				oz.	dr.	
1	J. F.	17 days.	11	10	½	9.75
2	H. C.	16 "	9	13	5	13.24
3	H. J.	19 "	9	10	3	10.07
4	R.	5 "	12	22	7	22.22
5	H. B.	6 "	12	15	5½	15.25
6	W. F.	5 "	12	10	1½	9.88
7	N. H.	14 "	12	17	3	16.85
8	C. F.	5 "	12	5	4	5.37
9	F. D.	7 "	12	14	4	14.8
10	E. S.	6 "	12	8	1	7.74
11	R. B.	3 weeks.	12	14	1	13.68

According to these statistics, infants under the age of three weeks nourished at the breast and suckled twelve times in the twenty-four hours require only one ounce, or not more than one ounce and a drachm, at each nursing; and the very small size of the stomach at this age shows, I think, that it cannot receive much more than this without distension. After the third week the amount required for healthy nutrition gradually increases.

Table II.—*Ages from One Month to Ten Months.*

No.	Name.	Age.	Number of nursings.	Milk nursed in 24 hours.		
				Quantity in weight.		Quantity in fluidounces.
				oz.	dr.	
1	A. S.	6 months.	8	26	1½	25.3
2	J. B.	4 "	9	38	½	36.8
3	W. G.	3½ "	8	24	2	23.5
4	L. B.	7 "	10	27	3½	26.6
5	W. L.	5½ "	11	28	7	28
6	J. C.	5 "	10	29	7	29
7	A. W.	3½ "	8	19	2	18.6
8	F. Van B.	2 m. 10 d.	7	24	4	23.7
9	E. W.	6 months.	10	12	4½	12.2
10	F. S.	3½ "	8	26	7	26.1
11	S. W.	4 "	8	23	5	22.9
12	J. G.	9 "	8	24	1½	23.4
13	B. J.	7 "	8	27	4	26.6
14	T. C.	6 "	10	26	6½	26
15	A. R.	6 "	10	21	6	21.1
16	C. H.	1 m. 5 d.	8	11	1½	10.84

The observations in the second table relate to infants between the ages of one month and ten months, and, with one exception, between the ages of two months and ten months. It was found that they received in the average 23.79 fluidounces of breast-milk in twenty-four hours. The number of nursings in the day and night varied from seven to ten. Therefore those infants between the ages of one—or, more accurately, two—months and ten months, if they took the breast eight times in the twenty-four hours, required three ounces at each nursing; if twelve times, they required two ounces each time.

The following observations were made by me in private practice. All the infants were well nourished, having the symptoms of normal, hearty digestion. An infant at the age of six weeks took six times in twenty-four hours one and a half ounces of milk, the same quantity of water, and one teaspoonful of barley flour with the starch converted into maltose by the action of malt (Liebig's method); an infant of eight weeks, of large size, took eight times daily two ounces of milk, two of water, and two scant teaspoonfuls of Liebig's flour; an infant of two months took eight times daily one teaspoonful of Liebig's flour, with three and a half of milk and three and a half of water; an infant of six months took at each feeding, and nine times in twenty-four hours, five tablespoonfuls of milk peptonized by Fairchild's process, with four of water.

According to my observations, infants in good health and well nourished do not all require or take the same amount of food. Some infants, like adults, need more food than others, but the following table indicates, I think, nearly the quantity required during the first twelve months of infancy, either of breast-milk or of food prepared so as to resemble as closely as possible breast-milk in consistence and nutritive properties. It will be observed that this table resembles closely that prepared by Professor Rotch of Harvard University, and published in his comprehensive and instructive paper on infant feeding in the *Cyclopædia of the Diseases of Children:*

TABLE III.—*Quantity of Food required in the First Year of Infancy.*

At each feeding.	Number of daily feedings.	Total daily quantity.
During the first week 1 oz.	10	10 oz.
At the third week 1½ oz.	10	15 "
At the sixth week 2 oz.	8	16 "
At the third month 3 oz.	8	24 "
At the fourth month 4 oz.	7	28 "
At the sixth month 6 oz.	6	36 "
At the tenth to twelfth months 8 oz.	5	40 "

TABLE IV.—*Observations relating to the Diet during Twenty-four Hours of Twenty-eight Healthy Children between the Ages of Two and Three Years, with an Average Age of Two Years and Eight Months.*

	Total amount.	Average for each.
BREAKFAST.		
Bread	6 lbs. 4 oz. 1 dr.	3.5 oz.
Butter	13 oz. 5 dr.[1]	0.45 oz.
Milk	22 lbs. 14 oz. 2 dr.	12.7 fl. oz.
DINNER.		
Meat	8 lbs. 0 oz. 5 dr.	4.6 oz.
Potatoes	6 lbs. 13 oz. 7 dr.	3.9 oz.
Milk	17 lbs. 9 oz. 7 dr.	9.4 fl. oz.
SUPPER.		
Milk	19 lbs. 12 oz. 1 dr.	10.5 fl. oz.
Bread	7 lbs. 1 oz. 2 dr.	4.0 oz.
Butter	14 oz. 7 dr.	0.53 oz.

DAILY AVERAGE FOR EACH CHILD.

Bread	7.5	oz. avoir.
Butter	0.98	oz. "
Meat (beef)	4.6	oz. "
Potatoes	3.9	oz. "
Milk	32.6	fl. oz.

[1] 354.6 fluidounces.

TABLE V.—*Observations upon Twelve Children between the Ages of Three and Six Years: Average Age, Four Years and Ten Months.*

	Total amount.	Average for each.
BREAKFAST.		
Bread	4 lbs. 6 oz. 3½ dr.	5.86 oz.
Butter	5 oz. 2 dr.	0.427 oz.
Milk	280 fl. oz.	23.3 fl. oz.
DINNER.		
Beef	9 lbs. 1 oz. 3 dr.	12.1 oz.
Bread	1 lb. 0 oz. 1 dr.	1.6 oz.
Rice	9 lbs. 12 oz. 7 dr.	13.0 oz.
Milk	112 fl. oz.	9.3 fl. oz.
Butter	2 oz. 2½ dr.	
SUPPER.		
Bread	2 lbs. 4 oz. 1½ dr.	3.0 oz.
Butter	5 oz. 5½ dr.	
Milk	192 fl. oz.	16.0 fl. oz.

DAILY AVERAGE FOR EACH CHILD.

Milk	48.6 fl. oz.
Beef	12.1 oz. avoir.
Rice	13.0 oz. "
Bread	10.3 oz. "
Butter	1.08 oz. "

TABLE VI.—*Observations relating to the Diet of Twenty-four Children—Twelve Boys, Twelve Girls—between the Ages of Four Years and Ten Years: Average, Six Years and Ten Months.*

	Total amount.	Average for each.
BREAKFAST.		
Bread	7 lbs. 13 oz. 3 dr.	5.21 oz.
Butter	12 oz. 3½ dr.	0.51 oz.
Milk	348 fl. oz.	14.5 fl. oz.
DINNER.		
Roast beef	18 lbs. 11 oz. 0 dr.	12.46 oz.
Potatoes	15 lbs. 8 oz. 3 dr.	10.30 oz.
Bread	1 lb. 6 oz. ½ dr.	0.92 oz.
Milk	192 fl. oz.	8.0 fl. oz.
Butter	4½ dr.	0.012 oz.
SUPPER.		
Bread	6 lbs. 2 oz. 3½ dr.	4.1 oz.
Milk	384 fl. oz.	16.0 fl. oz.
Butter	11 oz. 5½ dr.	0.16 oz.

DAILY AVERAGE FOR EACH CHILD.

Roast beef	12.46 oz.
Bread	10.23 oz.
Potatoes	10.3 oz.
Butter	0.99 oz.
Milk	38.5 fl. oz.

Compare the above observations with those of Professor Dalton, who estimates that a healthy adult taking active exercise requires each day—

Meat	16 oz.
Bread	19 oz.
Butter	3½ oz.
Water	52 oz.,

while one leading a sedentary life needs considerably less.

It will be seen by the above tables that even more food appears to be needed during the period of childhood than in adult life. We would suppose this to be so without statistical evidence, for the active exercise and rapid and progressive growth of this period necessarily require a large amount of nutriment. Moreover, while adults do well with solid food and water, statistics show that the best diet for children who have passed beyond infancy is one of milk, with solid food for at least breakfast and supper.

Although we are able, by observations, to determine the average amount of food required in twenty-four hours by children of various ages, we repeat that it would be wrong to prescribe a fixed amount for all children of a given age, for some need more than others. A child should never go hungry after a meal. In some of the best-conducted institutions of New York the children eat of plain food all that they desire at each meal, while in other institutions the food at supper is limited, but is abundant at the other meals. As children go to bed so soon after supper, it is proper to have this meal light and of such food as is easily digested.

The time required in the digestion of different foods has been investigated by Beaumont and Bichat, but their investigations relate to adults. The time occupied in the gastric digestion of various foods has been determined in adult cases by inspecting the interior of the stomach through a gastric fistula. No such opportunity has ever occurred, so far as I am aware, of inspecting the process of digestion in the interior of the stomach either in infancy or childhood. But recently experiments have been made for the purpose of determining the time occupied in gastric digestion in infancy. The importance of such experiments is apparent, for if we know how soon after feeding gastric digestion is completed and the stomach emptied, we will know how frequent the feeding should be. According to H. Leo, in an infant a few weeks old one hour suffices for the stomach digestion of the milk which it receives, so that this organ is already empty one hour after the nursing, and in a condition to receive more milk. In older infants, who receive more milk, the milk is retained longer in this organ, one and a half hours being required for the stomach digestion of human milk, and two hours for the digestion of cow's milk (*Berlin. klin. Wochenschr.*, No. 49, 1888). Recently (1889), Dr. Max Einhorn of New York has investigated the stomach digestion of infants, using a Nélaton catheter No. 14 A, with which he withdrew the contents or determined the emptiness of the stomach. He ascertained that in the infant receiving human milk the stomach was empty two hours after the nursing, and probably in one and a half hours. After feeding with equal parts of cow's milk and barley-water, the stomach was practically empty at a little before the close of the second hour. After feeding with milk and water, equal parts, the stomach was empty in about one and a half hours. The digestibility of several of the proprietary foods which are most in use was also ascertained in a similar manner. A considerable amount of these foods was still in the stomach undergoing digestion two hours after they were administered. These interesting and instructive observations of Dr. Einhorn indicate the intervals required in feeding with milk and with other foods.

and intervals for feeding.

It is seen that there is a general agreement in the result obtained by different observers in regard to the amount of food required at each feeding, and the proper intervals between the feedings, during infancy as well as *childhood.*

CHAPTER VIII.

ARTIFICIAL FEEDING.

OCCASIONALLY the mother is unable to suckle her infant, and a hired wet-nurse cannot be or is not obtained. Artificial feeding is then necessary. In the large cities this mode of alimentation for young infants should always be discouraged, for it frequently ends in death, preceded by evidences of faulty nutrition. A considerable proportion of those nourished in this manner thrive during the cold months, but on the approach of the warm season they are the first to be affected with diarrhœa and other symptoms indicating derangement of the digestive function. In New York City a large proportion of the artificially-fed infants who enter the summer months die before the return of cool weather, unless saved by removal to the country, but the mortality of these infants has been in a measure reduced of late years by improvement in the mode of feeding, and in the sanitary condition of the city. In the country and in small inland cities the results of artificial feeding are much more favorable. In elevated farming sections, on account of the salubrity of the air and the facility with which milk, fresh and of the best quality, is obtained, artificial feeding is attended by much less risk than in the cities.

Young infants, fed by the hand, obviously require food prepared so as to resemble as closely as possible human milk in its composition. Woman's milk in health is always alkaline. It has a specific gravity of 1031.7; cow's milk has a specific gravity of 1029. That of cows stabled and fed upon other fodder than hay or grass is decidedly acid. That from cows in the country with good pasturage is also slightly acid. In two dairies in Central New York a hundred miles apart, in midsummer, with an abundant pasturage, two competent persons whom I requested to make the examinations found the milk moderately acid immediately after the milking in all the cows.

How to feed infants deprived of breast-milk is a very important problem. The following results of a large number of analyses of woman's and cow's milk, made by König and quoted by Leeds, and of several of the best-known and most used preparations designed by their inventors to be substitutes for human milk, show how far these substitutes resemble the natural aliment in their chemical characters:

	Woman's milk.			Cow's milk.		
	Mean.	Minimum.	Maximum.	Mean.	Minimum.	Maximum.
Water :	87.09	83.6	90.90	87.41	80.32	91.50
Total solids	12.91	9.10	16.31	12.59	8.50	19.68
Fat	3.90	1.71	7.60	3.66	1.15	7.09
Milk-sugar	6.04	4.11	7.80	4.92	3 20	5.67
Casein	0.63	0.18	1.90	3.01	1.17	7.40
Albumen	1.31	0.39	2.35	0.75	0.21	5.04
Albuminoids . . .	1.94	0.57	4.25	3.76	1.38	12.44
Ash	0.49	0.14	. . .	0.70	0.50	0.87

The following analyses of the foods for infants found in the shops, and which are in common use, were made by Leeds of the Stevens Institute:

Farinaceous Foods.

	1. Blair's wheat food.	2. Hubbell's wheat food.	3. Imperial granum.	4. Ridge's food.	5. "A B C" Cereal milk.	6. Robinson's patent barley.
Water	9.85	7.78	5.49	9.23	9.33	10.10
Fat	1.56	0.41	1.01	0.63	1.01	0.97
Grape-sugar	1.75	7.56	Trace.	2.40	4.60	3.08
Cane-sugar	1.71	4.87	Trace.	2.20	15.40	0.90
Starch	64.80	67.60	78.93	77.96	58.42	77.76
Soluble carbohydrates .	13.69	14.29	3.56	5.19	20.00	4.11
Albuminoids	7.16	10.13	10.51	9.24	11.08	5.13
Gum, cellulose, etc. . .	2.94	Undeterm'd	0.50	. . .	1.16	1.93
Ash	1.06	1.00	1.16	0.60	. . .	1.93

Liebig's Foods.

	Mellin's.	Hawley's.	Horlick's.	Keasbey and Mattison's.	Savory and Moore's.	Baby sup No. 1.	Baby sup No. 2.
Water	5.00	6.60	3.39	27.95	8.34	5.54	11.48
Fat	0.15	0.61	0.08	None.	0.40	1.28	0.62
Grape-sugar	44.69	40.57	34.99	36.75	20.41	2.20	2.44
Cane-sugar	3.51	3.44	12.45	7.58	9.08	11.70	2.48
Starch	None.	10.97	None.	None.	36.36	61.99	51.95
Soluble carbohydrates .	85.44	76.54	87.20	71.50	44.83	14.35	22.79
Albuminoids	5.95	5.38	6.71	None.	9.63	9.75	7.92
Gum, cellulose, etc. . .	. . .	. . .	. . .	. . .	0.44	7.09	5.24
Ash	1.89	1.50	1.28	0.93	0.89	Undeterm'd	1.59

Milk Foods.

	Nestle's.	Anglo-Swiss.	Gerber's.	American-Swiss.
Water	4.72	6.54	6.78	5.68
Fat	1.91	2.72	2.21	6.81
Grape-sugar and milk-sugar . . .	6.92	23.29	6.06	5.78
Cane-sugar	32.93	21.40	30.50	36.43
Starch	40.10	34.55	38.48	30.85
Soluble carbohydrates	44.88	46.43	44.76	45.35
Albuminoids	8.23	10.26	9.56	10.54
Ash	1.59	1.20	1.21	1.21

It is seen by examination of the analyses of the above foods that all, except such as consist largely or wholly of cow's milk, differ widely from human milk in their composition, and although some of them—as the Liebig preparations, in which starch is converted into grape-sugar by the action of the diastase of malt—may aid in the nutrition and be useful as adjuncts to milk, physicians of experience and close observation agree that when breast-milk fails or is insufficient our main reliance for the successful nutrition of the infant must be on animal milk.

Cow's milk, being readily obtained, is commonly used as a substitute for human milk, compared with which it contains less sugar, but more casein and salts. Its composition, however, varies considerably, according to the food of the cow. The variations in the milk of the cow according to the nature of its food and other circumstances have been considered in a preceding chapter.

It is obvious from the above facts that the analyses of different specimens of cow's milk must differ greatly, and the same is true of the milk of the goat and ass, and probably of the ewe. In fact, different samples of the milk of the same animal may differ more from each other in their chemical character than the average milk of one animal from that of another.

The milk of the goat and that of the ass have been recommended as food for infants in preference to cow's milk, on the ground that they more nearly resemble human milk. But neither the milk of the ass nor goat, so far as its chemical character is concerned, would seem to possess any marked advantage over cow's milk. The ass's milk is procured with difficulty, and is seldom used. An objection to goat's milk is the unpleasant odor which it often possesses, due to the presence of hircic acid. It is stated, however, by Parmentier, that this odor is only noticed in the milk of goats that have horns. An important advantage in the city in the use of goat's milk is that the animal can be kept at little expense, so that even poor families who are not able to purchase and feed a cow can generally possess a goat from which fresh milk can be obtained at any time. Preference is to be given to goat's milk when fresh over cow's milk brought from the country, perhaps watered on the way, several hours old when received, and in commencing fermentation. But cow's milk of good quality and free from fermentative changes is probably not inferior to goat's milk as a food for infants, and from its abundance it must continue to be in common use for this purpose.

In order to solve the problem of the feeding of infants deprived of the breast milk, it will be well to recall to mind the part performed in the digestive function by the different secretions which digest food.

1st. The saliva is alkaline in health. It converts starch into grape-sugar. It has no effect upon fat or the protein group. It is the secretion of the parotid, submaxillary, and sublingual glands, which in infants under the age of three months are very small, almost rudimentary. The power to convert starch into sugar possessed by saliva is due to a ferment which it contains called ptyalin.

2d. The gastric juice is a thin, nearly transparent, and colorless fluid, acid from the presence of a little hydrochloric acid. It produces no change in starch, grape-sugar, or the fats, except that it dissolves the covering of the fat-cells. Its function is to convert the proteids into peptone, which is effected by its active principle, termed pepsin.

3d. The bile is alkaline, and it neutralizes the acid product of gastric digestion. It has no effect on the proteids. It forms soaps with the fatty acids, and has a slight emulsifying action on fat. The soaps are said to promote the emulsion of fat. Their emulsifying power is believed to be increased by admixture with the pancreatic secretion. Moreover, the absorption of oil is facilitated by the presence of bile upon the surface through which it passes.

4th. The pancreatic juice appears to have the function of digesting whatever alimentary substance has escaped digestion by the saliva, gastric juice, and bile. It is a clear, viscid liquid of alkaline reaction. It rapidly changes starch into grape-sugar. It converts proteids into peptones and emulsifies fats. While the gastric juice requires an acid medium for the performance of its digestive function, the pancreatic juice requires one that is alkaline. These important facts should be borne in mind, that such a mistake as prescribing pepsin with chalk mixture or the extractum pancreatis with dilute muriatic acid may be avoided.

5th. The intestinal secretions are mainly from the crypts of Lieberkühn, and their action in the digestive process is probably comparatively unimportant, but in some animals they have been found to digest starch. It will be observed that of all these secretions that which digests the largest number of nutritive principles is the pancreatic. It digests all those which are essential to the maintenance of life except fat, and it aids the bile in emulsifying fat.

It is seen from this brief review of the action of the digestive ferments that starch is digested in only a very small quantity by infants under the age of three months, and therefore that those foods which consist largely of starch afford but little nutriment at this age. The impropriety also of administering for days large quantities of an alkali, as is frequently done, is apparent from the above statement in regard to the action of pepsin, since it may retard or prevent gastric digestion.

In 1882 a conference was held in Salzburg, Germany, of physicians from various parts of the German Empire known throughout the world as specialists in the diseases of children. The purpose of the convention was to discuss the diet of infancy and childhood. They agreed that animal milk is the best substitute for human milk in the feeding of infants, either as the main food or as the basis of the food employed. Useful as some of the preparations of the shops are as adjuvants, nevertheless experience shows the soundness of the opinion expressed by the conference; and yet feeding with animal milk of the best quality must be carefully managed, or it will be found to disagree with the feeble and readily disturbed digestive functions of the infant.

Milk should always be given at a uniform temperature of about 99°. Employed habitually too hot or too cold, it frequently produces stomatitis or a more serious disease of the digestive organs.

Infants under the age of ten months should nurse from the nursing-bottle, and this as soon as used should, with the India-rubber tip and attachment, be immersed in a quart or two-quart bowl of cold water to which a teaspoonful of sodium bicarbonate has been added, and water should be drawn through the tube and nipple by suction with the mouth.

Cow's milk, though possessing nearly the same composition as human milk, nevertheless behaves differently in some respects in digestion. The casein of human milk coagulates in light flocculi in the stomach of the infant, so as to be readily acted on by the digestive ferments, while that of cow's milk forms large and firm coagula which are with difficulty digested. The irritating products of a slow and imperfect digestion frequently cause colic and fever, with more or less intestinal catarrh. Cow's milk, therefore, disagrees with many infants, who suffer from indigestion in consequence of the feeding, whose stools show masses of partly-digested casein, with abundant mucus, who fret from gastro-intestinal uneasiness and vomit often, and do not thrive like infants nourished at the breast. Therefore, the profession has long felt the need of some modification of cow's milk, so that it more closely resembles human milk in its digestion. This has in a measure been accomplished by the process known as peptonizing, by which the casein is digested or so far digested that it coagulates in flakes. Peptonized milk, or milk which is partially digested by artificial means, is prepared by the action upon it of extractum pancreatis and sodium bicarbonate. We may here briefly state the method. Extractum pancreatis gr. v and sodium bicarbonate gr. xv are added to one gill of tepid water, and this is mixed with one pint of tepid milk as fresh as possible. The mixture is allowed to stand in water having a temperature of about 100° to 110° for half an hour, or even one hour if it do not become bitter. After the half hour the milk should be frequently tasted, and if it be in the least bitter it should be immediately removed from the heat, and what is not used should be placed upon ice. If it be fully digested, it is too bitter for use. If it be slightly digested, the bitterness is not appreciable, or is so slight that it is readily taken by the infant, and the casein coagulates in flakes instead of large coagula. Professor Leeds recommends the following method as an improvement. In his opinion it produces milk so closely resembling breast-milk in its chemical character and behavior that he designates it humanized cow's milk:

1 gill of cow's milk.
1 gill of water.
2 tablespoonfuls of rich cream.
200 grains of milk-sugar.
1¼ grains of extractum pancreatis.
4 grains of sodium bicarbonate.

"Put this in a nursing-bottle, place the bottle in water made so warm that the whole hand cannot be held in it without causing pain longer than one minute. Keep the milk at this temperature for exactly twenty minutes. The milk should be prepared just before using." Messrs. Fairchild have prepared according to the above formula what they designate a peptogenic powder in a can accompanied by a measure which holds sufficient for peptonizing two ounces of milk with half an ounce of cream. The use of Fairchild's peptogenic powder simplifies the process of peptonizing. The measure full of the powder, one tablespoonful of cream, four tablespoonfuls of milk, and four tablespoonfuls of water are mixed in a convenient vessel and maintained six minutes, with constant stirring, at a temperature so hot that it can barely be sipped. The casein by this process, though but partially digested, coagulates in flakes. I have, I think, improved this food for a large proportion of infants, especially for those over the age of three months and in the summer season, by substituting barley-water for plain water. Barley flour is boiled dry seven days in a double boiler, so that a considerable portion of the starch is converted into dextrin, and the gruel is made by adding a heaped teaspoonful of the flour to eighteen of water. The dextrin in the barley gruel thus prepared is assimilated by the youngest child, and any starch-granules which may not be converted into dextrin separate mechanically the particles of casein, and aid in preventing the formation of curds in the stomach.

Peptonized milk is a useful addition to the dietetic preparations for infants. By peptonizing is accomplished what physicians have long felt the need of—to wit, a mode of preparing cow's milk so that its casein coagulates in flakes like that of human milk. Milk employed for this purpose should be as fresh as possible, but unfortunately in hot weather, when there is most need of having a food for artificially-fed infants which bears the closest possible resemblance to human milk, in order to prevent the summer diarrhœa, much of the cow's milk when it reaches the cities, twenty-four hours after the milking, has begun to undergo fermentation, and is therefore unsuitable for peptonizing, though employed for this purpose. This is probably one of the chief causes of the fact that peptonized milk not unfrequently disappoints our expectations. The peptonizing of milk rests on a scientific basis, and as clinical experience thus far has demonstrated the usefulness of milk prepared in this manner in the feeding of infants in a certain proportion of cases, it will probably continue to be regarded as one of the best substitutes for breast-milk. It has also been found useful for children with feeble digestion who have passed beyond the period of infancy. But recently a great improvement has been made in the preparation of cow's milk for the nursery by sterilizing it by the prolonged action of heat. It is placed in a steamer and maintained at nearly the heat of boiling water one and a half or two hours. This destroys any microbes which may have fallen into it, and it appears that the prolonged action of heat increases the digestibility of the casein, by rendering it more liable to coagulate in flakes. Milk thus prepared, and given with some farinaceous food in which the starch is converted into dextrin or grape-sugar, will frequently agree with young infants and be fully digested without the aid of the peptogenic powder.

It is known that infants prior to the third month can digest only a very small amount of starch, since the salivary and pancreatic glands, whose secretions convert starch into glucose—a necessary change in digestion—are almost rudimentary in the first months of infancy. In a monograph relating to *Infant Diet* written by Professor A. Jacobi, and revised, enlarged, and adapted to popular reading by Dr. Mary Putnam Jacobi, it is stated that the parotid glands, which, together, weigh 80 grains at fifteen months and 120 grains at two years, weigh but 34 grains at the age of one month. In several instances we weighed the pancreas taken from the bodies of infants who had died under the age of six months in the New York Infant Asylum. Its weight was very different in those whose ages were about the same: in several under the age of four months it was less than one drachm, and in some more than one drachm, but in no instance did it reach two drachms. The submaxillary and sublingual glands, which also secrete saliva, are comparatively insignificant in young infants, so that the combined action of the parotid, submaxillary, sublingual, and pancreatic secretions must be inadequate for the saccharification of the starch which ordinary farinaceous food contains during the first three or four months of infancy.

But it is now ascertained that the salivary and pancreatic secretions are not the only agents by which starch is digested. The mucous surface furnishes an "epithelial ferment which assists in the change, so that the secretions from the buccal and intestinal surfaces materially aid in the digestion" (*Revue des Sciences méd.*, 1879, by Charles Richert; also remarks by Profesfessor Flint, Jr., in *Physiol. of Man*).

It appears, therefore, that young infants are able to digest a certain amount of starch, but a much smaller proportion than those who are older; and in the preparation of farinaceous food this fact should be borne in mind. Young infants can digest the two derivatives of starch—to wit, dextrin and grape-sugar—and it seems judicious, since they are more readily assimilated, to employ them in place of starch for sick children and for all children under the age of six months.

The late Baron Liebig, who devoted considerable time in the last years of his life to the study of the food of infants, was the first who recommended the conversion of starch into grape-sugar by the action of the malt diastase, and this constitutes the special excellence of several of the infant foods which under other names have been largely used, and often with good results. But of all the farinaceous foods containing derivatives of starch which are found in the shops, and which have been used and recommended for infant feeding, barley flour with a considerable part of its starch converted into dextrin by the prolonged action of heat (seven days at 212°), is probably one of the best, if not the best. Containing no admixture, it can be preserved without change for an indefinite time, and as the youngest child can digest dextrin as well as peptonized milk, the combination of the two makes a useful food for infants in sickness as well as in health.

But whatever may be the dietetic preparation designed for infant feeding, we have stated above that animal milk should form the basis. This fact is generally recognized, and the various proprietary foods either contain a large proportion of milk or milk is added to them in the nursery. Hence, during the last few years much attention has been directed to the milk-s
ply of the cities, and in some of the cities it is under strict surveillan
is now regarded as important that the health and condition of the cow

distant dairies should be closely inspected, that their milk should not be sent to market until several days after calving, and that the pastures in which they feed should not only have abundant grass and clover, but be free from foul water and noxious weeds. One at least of the companies that prepare food for the nursery insist on the observance of the above conditions in obtaining their milk from the farmer. Immediately after the milking the milk should be placed in open cans and, except in midwinter, surrounded by ice or cold water, so as to reduce its temperature as soon as possible to 60° or 65°. We have stated elsewhere that neglect to treat milk in this manner in a hot summer day led to the development of tyrotoxicon in six or eight hours after the milking, and the poisoning of the guests of two hotels at Long Branch. In view of such cases the sterilization of milk, which we have recommended above, merits more than a passing notice.

Dr. Soxhlet of Germany was among the first to recommend the sterilization of milk by heat in an interesting monograph published in 1886. He alludes to the fact that particles of manure and other dirt fall into the milk in milking, and are liable to set up fermentation, which renders it unsuitable as a food. Drs. Jeffries, Warner, A. Jacobi, and A. Caillé have also written instructive papers commendatory of the sterilization of milk by steam. Dr. Warner states that in his experiments milk thus sterilized has remained sweet five weeks. Soxhlet's mode of sterilizing milk is described by Dr. Caillé as follows:

Ten 5-ounce bottles are filled with milk to within half an inch of the neck. Into each bottle a perforated rubber stopper is pressed. The bottles are placed in a tray which is set in a pot of water. After the water has come to a boil and expansion has taken place, the glass stoppers are pressed into the perforated rubber stopper, thus hermetically closing each bottle. The milk remains in the boiling water fifteen to twenty minutes longer, and is for that length of time under pressure in a temperature of 212° F., which is sufficient to destroy all germs and impurities liable to produce fermentation. Milk so prepared will keep sweet four to six weeks, according to Soxhlet.

When the milk is to be used the bottle is put into hot water a few minutes, until the contents are warm. The stopper is then removed and an ordinary nipple attached. A long feeding-tube may also be used in the usual way if desirable. Milk remaining in the bottle after the child has been fed is thrown away.

The Arnold steam sterilizer (an American invention) has also lately been brought to the notice of the profession. It is an ingenious apparatus fulfilling all the requirements, not allowing the escape of steam into the room, and furnished at a reasonable price. But, as Dr. Warner remarks, the simple kitchen steamer found at the hardware store answers the purpose if supplied with the proper bottles. Milk sterilized by steaming in this manner, and diluted with boiled water according to the age of the child, may agree with the youngest infant.

Meigs and Pepper recommend for artificially-fed infants the admixture of prepared gelatin or Russian isinglass with the milk, and they state that in their practice, extending over many years, infants "have thriven better upon it than upon anything else." A piece of gelatin two inches square "is soaked for a short time in cold water, and then boiled in half a pint of water until it dissolves—about ten or fifteen minutes." To this is added, with constant stirring, the milk, containing some farinaceous food. Others who have used food prepared in this manner speak well of it. Although gelatin contains little nutriment, its presence may aid digestion, and a food recommended by hysicians of such experience as Meigs and Pepper is worthy of trial [illegible] cases of habitual indigestion or of intestinal catarrh in which the ordinary food disagrees.

Milk should be the chief article of .food during infancy, but the older the infant becomes the larger should be the proportion of solid food given with it. After the first year the food may be made of such consistence as to be given with the spoon. In the second year and subsequently a pap may be made of stale bread boiled in water sufficient to cover it, and mixed with fresh milk, care being taken that all lumps are reduced to a pulp. Beef tea is a laxative, on account of the salts which it contains, as is also chicken tea; but a small or moderate amount of it may be given once a day. Stale wheat bread or soda cracker should be crumbled in it, and soaked so as to be soft. If there be diarrhœa the ordinary beef tea should not be allowed, on account of its laxative effect, but the expressed juice may be given instead. Few vegetables are proper for infants under the the age of one year, but the potato, baked and mashed so as to be like flour, may be given at the tenth or twelfth month. It contains a large amount of starch, but appears to be readily digested by infants of the age mentioned if given once a day in moderate quantity, with a little butter and salt added. In the second year a greater variety of food may be allowed, but the full diet of the table must not be given till after infancy, or at the age of three years. In the beginning of the second year the infant is weaned. He has twelve teeth, eight incisors, and four molars, which, with their broad surfaces, are designed for chewing. Let him have now, once or twice each day, in addition to the food which has previously been employed, a small piece of roast beef, rare done and cut very fine. Other meat, as mutton, may sometimes be given instead. After the age of eighteen months light puddings of farinaceous substances, properly prepared, as of rice and corn meal, may be added to the dietary.

All the teeth of the first set have appeared at the age of two years and five months, and the time has now arrived when a more marked transition may be made from liquid to solid food. Certain fruits may be allowed, even before this period, as also the jellies of most berries and of fruits, which being deprived of seeds and parenchyma are for the most part readily digested, while they give a relish to the farinaceous food with which they are eaten. Pastries as ordinarily made, whatever fruits they may contain, are too rich and indigestible for young children. The following judicious rule for the preparation of fruits for children, copied in popular treatises on hygiene of infancy and childhood, is from *Murray's Modern Cookery Book*: . . . . "Put apples sliced, or plums, currants, gooseberries, etc., into a stone jar, and sprinkle among them as much Lisbon sugar as necessary: set the jar in an oven or on a hearth, with a teacupful of water to prevent the fruit from burning, or put the jar into a saucepan of water till its contents be perfectly done. Berries and fruits thus prepared and the fruit jellies are best eaten spread on bread and butter or on soda crackers."

CHAPTER IX.

BATHING, CLOTHING, SLEEP, EXERCISE.

BATHING is now recognized in all civilized countries as one of the chief promoters of bodily comfort and health. The first bathing of the infant, which is immediately after birth, should be in water at a temperature a little below that of the blood—namely, at about 96°—after which the general bath is inadmissible until the navel-string is detached. In the infant reaction of the surface when chilled is tardy and uncertain, and therefore there is great danger of catching cold when the surface is cooled by water and does not quickly react. It is a matter of daily observation that infants become chilly and their extremities remain cool in a medium, whether air or water, in which older children and adults would have comfortable warmth. Therefore they are liable to contract bronchitis, sore throat, intestinal catarrh, or other inflammation from very slight exposures. This fact must be borne in mind in considering the subject of bathing.

During the first year after the detachment of the navel-string the bath should be employed daily, but not longer than three minutes, during which time thorough ablution can be performed. Different authorities disagree in regard to the proper temperature of the bath during the first months of infancy. Steiner of Prague, a high authority in children's diseases, says: "During the first nine months the infant should have a daily bath a little above blood heat," but most authors recommend a temperature a little below blood heat. In my opinion it should be at 92°, which is considerably below blood heat, but which communicates a moderately warm sensation to the hand. After the age of ten months, or even of eight months for vigorous children, the temperature of the bath may be reduced to 90°, and it should not be lower than this during the remainder of infancy, or if it be used a little lower care should be taken to produce reaction by brisk rubbing and exercise after a short bath. At the close of infancy, or at two and a half years, the temperature may be still further reduced, but it should not, even for the most robust children of eight or ten years, be below 78°, which is recorded on our thermometers as the temperature of summer heat, and is about that of our northern lakes during midsummer.

The rules given in the books, not to bathe or direct a child to be bathed immediately after eating or after much exercise, when the pores of the skin are perspiring, should be heeded. The head should first be wet with the water, and castile soap should be applied over the surface to ensure cleanliness. The strongly-scented toilet soaps sometimes contain rancid fats or other deleterious substances, and should be regarded with suspicion. In hot weather a daily bath is advisable, but in the cooler months it is sufficient if the child bathe twice or three times in the week. If, from lack of conveniences or for other reasons, general bathing be dispensed with and the surface be washed from a basin or bowl, cooler water may be used than would be proper for the general bath, and a longer time to complete bathing would evidently be required. The bath-room should be comfortably warm, and after the bath the surface should be briskly rubbed with flannel or, in case of older children, with a suitable coarse towel, and exercise afterward encouraged to ensure full reaction. In New York, in one of the largest and best managed asylums, both boys and girls are allowed to bathe in bath-houses in the Hudson when the water and weather are not too cool.

It may be well to add to these general remarks on bathing the recent remarkable statement of a high authority on thermometric observations and temperature, that during hot days a bath in hot water, employed in the hours of greatest atmospheric heat, tends to reduce the heat of body and to preserve its normal temperature during the remainder of the day. Wunderlich says: "In tropical countries and in very hot seasons no means of cooling is so lasting as a bathe or douche of very warm water."

CLOTHING.

One of the most important duties of the mother or nurse is the selection of clothing for children which will be suitable for their age and the season. In the matter of dress, as in that of diet, many errors are unconsciously committed. In a room of proper temperature, which during the cool months should be 70° for infants and 68° for children old enough to run about, the head should never be covered unless in case of young infants; but the sides of the head, as well as the neck and shoulders, may be lightly covered in sleep. It is the common practice to leave off the "bellyband" which is applied after birth when the infant has reached the age of three or four months; but from the fact that infants so often take cold, especially at night by throwing off bedclothes, both in cool weather, when the temperature of the apartment may fall below 70°, and in summer, when there are currents of air through open windows, I advise the continuance of the band during the first year or eighteen months. In the summer it should be made of light merino and in the winter of flannel. It should never be so thick and heavy as to be uncomfortable, or so snug as to interfere in the least with the free movements of the chest and abdomen in respiration. It should extend to and not over the ribs, and should be secured either with safety-pins or a few stitches. If excoriations or prickly heat appear on the skin under the band in hot weather—a very common eruption in infancy—the surface should be dusted with subnitrate of bismuth or a mixture in equal parts of lycopodium and oxide of zinc, and a single layer of linen should be applied over it and under the band. If the eruption be severe, it might be best to substitute a linen or soft muslin band for a time in place of the merino.

A cardinal principle in the clothing of children is that the garments should always be so loose as not to interfere in the least with the functional activity of organs. The fitting and putting on of the dress is left too much to the discretion of the nurse, who is usually ignorant of the important facts in physiology, and unwittingly and with the best intentions injures her charge. I have often interposed to loosen the dress of young infants, which was so tight as sensibly to embarrass respiration; and the case of a new-born infant has been reported to me in which it seemed probable that death resulted from this cause. Infants especially, who are so liable to pulmonary collapse and intestinal hernia, should have loose covering of both chest and abdomen. Pressure over the stomach always feels uncomfortable, and this organ, almost as much as the lungs, needs full expansion and free movement in order to perform its function of digestion properly. The same is true also of the intestines, but they tolerate compression better, and their movements are less impeded than those of the stomach by too tight dressing. Another part where too snug an application of the dress does very great harm is the neck, since moderate pressure in this region may retard the circulation of blood through very important vessels—to wit, those which supply the brain or return blood from this organ. The [illegible] neck should always be so loose that the four fingers of [illegible] troduced underneath it. *Skirts upon girls are s* [illegible] tightly around the waist and over the stomach. This should never be allowed, but they should always be supported by shoulder-straps and be loose around the waist.

Clothing protects the body according to its thickness and the feebleness of its conducting power of heat. Woollen, fur, and feather garments have very low conducting power, and wool, from its plentiful supply and cheapness, must always be the material which is chiefly worn in the winter season; while cotton, and in still greater degree linen, are active conductors of heat, allowing its quick escape from any part of the body which it covers, and they are therefore the proper material for summer clothing.

The color of the garment matters little as regards the escape of heat from the body, for whatever its color its surface next the body is necessarily dark from the exclusion of light; but the color is important as regards the absorption of heat from the atmosphere and the solar rays. Black has the highest absorptive power, while white has the least, and the mixed colors have absorptive powers which are intermediate. In experiments made with shirtings of different colors, while white received 100° F., black received 208° F. A light color is therefore the best to dress children in during the hottest weather.

The covering which is proper for the head of a child when outdoors must evidently vary considerably in different seasons and in different states of weather. Many a young child with scanty growth of hair has contracted that painful disease, inflammation of the ear, followed perhaps by a protracted discharge and more or less impairment of hearing, in consequence of taking cold from insufficient covering of head and ears in inclement and changeable weather; even leaving off accidentally a band or tie which a child is accustomed to will sometimes give it a cold.

In this connection I wish to call attention to the common and dangerous practice among the poor of allowing children to go bareheaded in the sun during the season when the atmospheric heat is highest. Not a summer passes in which I do not meet cases of inflammation of the brain which I believe to be largely due to exposure to the sun's rays. There is no better and safer covering for the head of a child who is allowed to go in the open air during the hot weather than the light, cool, and inexpensive straw hat.

The feet should always be warm and dry, the shoes worn in wet weather being waterproof; and special care should be taken in the selection of shoes that they be pliable and loose, so as to allow freedom of growth without compression of any part. If during the period of growth proper precautions are taken in this respect, the chiropodist would have little to do in subsequent years. Corns, bunions, and ingrowing toe-nails originate from shoes hard and unyielding or too tightly fitting.

SLEEP.

The newly-born infant until about the age of six or eight weeks requires not less than twenty-one hours' sleep each day. It sleeps, therefore, most of the time when not awake for the purpose of nursing, bathing, and change of clothing. If it do not have this amount of sleep and be wakeful, it is probably not well. After the eighth week it requires less and less sleep with advancing age, and at the end of the first year fourteen hours of sleep each day suffices. At the age of eighteen months about twelve hours of sleep are needed, a part of which should be in the middle of the day. At the age of two and a half or three years, and subsequently during childhood, about ten hours are required at night, and if the child be tired or sleepy in the day-me it should be allowed to sleep. Sufficient sleep is essential for the normal development of the body and the normal functional activity of the organs in infancy and childhood.

During sound sleep the senses no longer receive and communicate impressions. They enter into the state of sleep in the following order: Sight is first lost, and then touch, taste, smell, and lastly hearing. In sound sleep also the frequency of the respiration and pulse is slightly diminished. Excitation of any of the senses has a tendency to prevent sleep. A bright light, rough handling, and loud noises render young children wakeful, and, if thereby deprived of the needed sleep, fretful. Slight excitation of certain of the senses, as by a low humming voice or gentle rocking, on the other hand, tend to procure sleep. The time of soundest sleep is about one hour after its commencement, after which it becomes gradually less profound until the child awakens. The child should be habituated to taking its sleep at a certain hour, and if it be well and not subjected to any unusual excitement, it will be drowsy and will sleep readily when that hour arrives. In the asylums of New York, where from long and abundant experience the management of children is systematized, infants and the younger children are usually put to bed between six and seven, and the older children between seven and eight, o'clock, the last meal being light and readily digested.

Various causes produce wakefulness in children. We have already alluded to strong impressions upon the senses. A swollen and tender gum, indigestion with flatulence and colic, eczema with tenderness and itching, as well as the more serious forms of sickness, produce wakefulness. Unpleasant and exciting sensations of whatever kind, reaching the brain, keep up a state of excitement and prevent its repose. The fretful and sleepless baby in the hot and stifling air of the tenement-house in the heat of summer soon falls asleep when taken to cooler air outside.

It is scarcely necessary to call attention to some accepted and important facts regarding the dormitory of children. Free ventilation is required either through ventilators or through the windows, slightly raised in winter, and more widely open in summer. A small room should not contain more than two children, and the temperature of the sleeping apartment should be at about 68°. A temperature too cool causes wakefulness.

The amount of blood circulating in the brain in sleep is less than when awake, and too active a circulation, as from fever or much excitement, causes wakefulness. If the head be unduly hot, and in the infant the anterior fontanel pulsate forcibly, a cloth wrung out of cold water should be applied over it, and a general bath or hot foot-bath should be used in order to diminish the cerebral circulation. On the other hand, if the brain be not properly nourished in consequence of poverty of the blood, as is sometimes the case with pallid and scrofulous children, the diet should be more nutritious and iron may be needed.

If the sleeplessness continue when all causes so far as possible have been removed, medicinal treatment will be necessary. Frequently in families before the physician is summoned, the so-called soothing syrups have been used, which contain an opiate, and the use of which should be forbidden. The safest remedy is one of the bromides, which may be given dissolved in water in three-grain doses to an infant between the ages of six and twelve months, and one grain additional should be added for each year, or the aniseed cordial of the National Formulary. The dose if required may be repeated after two hours.

EXERCISE.

Exercise is an important hygienic requirement. Harm often results from *modes of exercise which are not adapted* to the age. Occasionally I meet cases of permanent bow-leg which have manifestly resulted from attempts to make infants stand at the age of four or five months. They should never be encouraged to walk or stand till about the age of one year, and if they do at the age of nine or ten months let it be voluntary, and not taught by standing them upon their feet. In case of infants with rachitis—which disease is common in cities, and is characterized by a lack of lime-salts in the bones, and can be detected by great backwardness in teething—attempts to stand or walk for any length of time should be discouraged till by the use of lime-salts and cod-liver oil and improvement of the general health the rachitis is cured. Much of the permanent deformity which mars the beauty and symmetry of adult life originates in rachitis and might have been prevented.

The infant before he is old enough to stand takes sufficient exercise in a way that is natural and harmless. Let him lie upon his back in the crib or on the floor, with a blanket under his body and pillow under his head, with all his clothes loose, so as not to restrain the free movement of his limbs. A healthy infant seems to enjoy this attitude, moving all his limbs sufficiently to give them the required exercise, and evincing his delight and exuberance of life by utterances which are as expressive as words.

In the cool months of our latitude infants should not be taken outdoor until the age of three months, and then only for a brief time in the warmest part of the day; but in the summer they should begin to receive outdoor air and exercise at the age of one month. In warm weather the face should never be covered by a veil or otherwise, and air and light should have free access to it. The rays of the sun, however, from a clear sky should be excluded, either by a parasol or the shade of trees or houses or by the carriage in which the infant is conveyed. In cold weather or when there is a strong wind the protection of a veil is needed. Rude tossing of infants, which is common in families, should always be forbidden. Its effect on the cerebral circulation is likely to be bad, and it involves risk of serious accident. In one instance to my knowledge death resulted from injury received in this way.

Walking, as it is the natural, so it is the best, exercise for the older infants and during the period of childhood. It promotes digestion when not carried to the extent of fatigue, and gives gentle exercise to all the muscles. The baby-carriage answers a useful purpose when combined with walking. With the ordinary hired nurse it is safer for the infant to be taken out in this vehicle than in the arms, for if the nurse in careless walking should trip great harm might result. In one instance which came under my notice convulsions and idiocy were plainly referable to the fall of an infant from its nurse's arms upon its head.

The ordinary lawn sports of childhood, as croquet for both sexes, playing ball or quoits for boys, which are rendered more exciting by the spirit of rivalry, are also useful for muscular exercise and development, while they involve little danger. The swing affords a pleasant exercise, and with the propulsion required it gives gentle but efficient activity to most of the muscles.

Many of the gymnastic exercises are too severe, involve too much risk of ruptured tendons, sprained joints, and even of dislocated or broken limbs.

Among all the ingenious inventions to provide sports and pastimes for children, there are none better than gardening and farming where facilities will allow them, conjoined with the ordinary household duties. The healthy and robust development of the farming population, their almost complete immunity from rachitic and scrofulous ailments, is attributable to their outdoor mode of life and the many kinds of healthful work which farm-life requires. Such work is always in the highest degree beneficial for children old enough to participate in it, while it develops the habit of productive industry.

CHAPTER X.

DIAGNOSIS OF INFANTILE DISEASES.

GENERAL OBSERVATIONS.

DISEASES in early life differ in important particulars from those occurring in maturity. Some which are common in the former age are unknown or are rare in the latter, and those which occur equally at all ages often present peculiar symptoms and a peculiar clinical history in the young. Therefore physicians who are skilful in treating adults may be unskilful in treating children. Excellence as a physician of children can only be achieved by special and continued study of their ailments.

Again, as regards the diseases of infancy, in which period there are a great amount of sickness and a large mortality, diagnosis must evidently be made from the objective symptoms—from examining the features, attitude, utterances, the pulse, respiration, etc., and inspecting the surfaces, so far as they are accessible to view, and the eliminated products. We lack for this age the important information which speech affords. Some general remarks, therefore, in reference to the appearances and functions of the system in early life, and the changes which they undergo in various pathological states, seem requisite in order to a clearer appreciation of the symptoms and more ready diagnosis of individual diseases.

FEATURES, EXTERNAL APPEARANCE OF THE HEAD, TRUNK, AND LIMBS IN DISEASE.

In the new-born, as soon as respiration and the new circulation are established, the cutaneous capillaries become distended with blood and the skin presents a congested appearance. By the close of the first week this external hyperæmia begins to abate, and is soon replaced by the normal capillary circulation.

Icterus is common in the first and second weeks. Bouchut attributes it to mild hepatitis. A much more plausible view of its causation, and probably the correct one, is that of Frerichs, who attributes it to the effect on the hepatic circulation of ligation of the umbilical cord. By ligation the current of blood through the umbilical vein to the liver ceases, the amount of blood in the hepatic capillaries, which connect with the branches of the vein, diminishes, and then, according to Frerichs, by the law of diffusion, diversion occurs of a part of the bile from the hepatic cells into the capillaries, while the rest flows in the normal manner into the bile-ducts. The degree of jaundice is proportionate to the amount of bile which enters the circulation. Icterus neonatorum is ordinarily not a disease of importance. If the general health remain good, it subsides without medicine in the course of one or two weeks, when the circulation through the liver becomes equalized and regular.

The surface or portions of the surface of the new-born often present for a *few hours a livid color, due to the* mode of delivery. Protracted lividity occurs from atelectasis or malformation of the heart or great vessels; lividity induced by exertion or excitement, while the respiration is normal, indicates malformation of the heart or vessels; temporary lividity sometimes occurs in severe acute diseases, especially those of the respiratory organs; lividity, whether temporary or permanent, is a sign of imperfect decarbonization of the blood.

The cheeks of children are congested in febrile and inflammatory diseases, except in a cachectic or prostrated state of the system. Transient circumscribed congestion of the face, ears, or forehead constitutes a reliable sign of cerebral disease. Strabismus occurring in connection with febrile reaction, oscillation of iris, inequality of pupils, and drooping of upper eyelids, also denote cerebral disease. The pupils are contracted during sleep, evenly dilated in death.

Dilatation of the alæ nasi during inspiration, with contraction of the eyebrows and a countenance indicative of suffering, attends severe inflammation of the respiratory organs. Absence of tears during the act of crying shows a severe and probably fatal form of disease in infants over the age of four months.

Rapid wasting of the features, causing deep suborbital depressions, prominence and pointedness of the cheek-bones and chin, and hollowness of the cheeks, are signs of severe diarrhœal malady; the most striking examples of this sudden collapse of features are afforded by patients affected with cholera infantum. In severe cases of this disease the physiognomy, from a state of fulness and health, presents in a few hours such a wasted and senile appearance that the friends with difficulty recognize the features with which they are familiar. Muscular tonicity is also greatly impaired in this disease—that of the orbicular muscles of the lips and eyelids to such an extent that the mouth is open and the eyeballs exposed during sleep. Great emaciation occurring gradually is a symptom of subacute or chronic disease of a grave character, often of tuberculosis or chronic entero-colitis.

Strabismus sometimes occurs in children who have no serious disease. It is then due to simple paralysis of one or more of the motor muscles of the eye. But when supervening upon other symptoms of a neuropathic character it is a grave symptom, indicating organic disease of the encephalon, as effusion, meningitis, etc. A permanently downward direction of the axes of the eyes, with smallness of the face and great expansion of the cranium, is a sign of chronic hydrocephalus. The scalp in this disease is tense, bald, or sparingly covered with hair, the fontanels and sutures open and enlarged, and the cranial bones yield to pressure. Great expansion of the cranium above the ears, while the frontal portion is not enlarged or but slightly, denotes hypertrophy of the brain.

The appearance of the general cutaneous surface possesses much greater diagnostic value in the diseases of infancy and childhood than in those of adult life. The eruptive fevers, so common in the young and comparatively rare in the adult, reveal themselves to us in great part by the changes which they cause in the appearance of the integument. The peculiar color of the skin in constitutional syphilis, hereafter to be described, and which is more marked in infancy and early childhood than at any other age, is a diagnostic sign of great value in obscure cases. In the infant the cold stage of intermittent fever is manifested, not by muscular tremors, but by lividity, pallor, and the goose-skin appearance of the surface.

Bulbous enlargement of the fingers and incurvation of the nails are signs of cyanosis, and therefore of malformation at the centre of the circulatory apparatus, or of tuberculosis or chronic pulmonary disease attended by malnutrition. Enlargement of the spongy portions of bones, causing prominences, softness, and bending of the bones, and consequent deformity of the limbs, patency of the fontanels, a large and square shape of the head from calcareous deposit external to the cranium, and delayed dentition, are among the signs of rachitis.

In early infancy the glands of the skin and mucous surfaces, or which connect by their orifices with these surfaces, are slightly developed. Therefore, sensible perspiration and lachrymation are rare under the age of three months. A thick Meibomian secretion of a puriform appearance collecting between the eyelids is an unfavorable prognostic sign; it indicates a state of great depression; it is observed most frequently in cerebral and intestinal maladies shortly before death. Passive congestion of the vessels of the conjunctiva sometimes occurs under the same circumstances, due to feebleness of the heart's action and imperfect capillary circulation. It indicates the near approach of death.

ATTITUDE—MOVEMENTS—THE VOICE.

A sharp, piercing cry, head firmly retracted, flexure of the limbs with a degree of rigidity, abduction of the great toe, clonic or tonic spasm of the muscles, irregular movements of one or more limbs, with consciousness impaired or with mental hallucinations, are symptoms of grave disease of the cerebro-spinal system. Irregular muscular movements, partly controlled by the will and occurring during full consciousness, are symptoms of chorea, a disease nearly always ending favorably in children, though incurable in the adult. Contraction of the eyebrows, turning of the eyes and face from light, avoidance of noises as if painful, are signs of headache. Frequent carrying of the hand to the ear and pressing with the ear against the breast of the mother or nurse are symptoms of otalgia. Frequent carrying of the fingers to the mouth in connection with fretfulness or other symptoms of suffering indicates stomatitis, gingivitis whether from difficult dentition or other causes, painful pharyngitis, or some obstructive disease of the larynx. Frequent rubbing or pressing the nose may be due to intestinal worms or intestinal irritation from other causes. It may be due to coryza or headache. Frequent forcible rubbing or striking the nose should lead to a careful examination and perhaps guarded prognosis. It often indicates grave cerebral disease, and may be a precursor of convulsions.

In severe obstructive disease of the larynx the child is restless, moving from side to side. In most inflammations of the respiratory organs a semi-erect position gives most relief. The voice in severe laryngitis is often hoarse or indistinct, and is usually so in the pseudo-membranous form; in pleuritis or pneumonitis it is restrained and abrupt, since the movements of the walls of the chest give pain.

The voice in severe diseases of the abdominal organs is feeble and plaintive. It is sometimes short and restrained in acute dyspepsia, in peritonitis, and in cases of great abdominal distension. The horizontal position gives most relief in abdominal diseases. In case of abdominal pain the patient often presses his hand upon the abdomen and flexes his thigh over it. Perfect quietude, with features sunken and unchanged by smile or crying, is a symptom of severe and exhausting diarrhœal affections.

RESPIRATORY SYSTEM.

The respiration of the infant under the age of six months is
ular, and it is more irregular the nearer the time to birth. If
infant be closely observed, it will be seen to sigh often; it

uniformly and regularly for a moment, and then, without appreciable cause, the respiration is intermitted; it holds its breath when it smiles or moves its head or even its limbs; it is very subject to hiccup; this is more common the first week of life than at any other age. So much is the breathing of the young infant disturbed by these causes that the number of respirations ordinarily varies in consecutive minutes. In order, therefore, to determine with accuracy the frequency of the normal respiration for this time of life it is necessary to take the average of several observations.

At birth, while the function of the heart has for months been regularly performed, the lungs are still quiescent. The one organ has been active during the greater part of fœtal development, the other is yet untried. Hereafter, in the new order of things, so intimate is the relation between the heart and lungs that the proper performance of the function of the one is essential to that of the other. Therefore, the commencement of respiration and the return of circulation, which is modified and temporarily arrested at birth, are nearly simultaneous. Respiration begins in the first half minute of independent existence; often, indeed, attempts to inspire occur before delivery is completed. The exceptions to this early establishment of respiration are after tedious or unnatural births. The establishment of the new circulation is a moment later.

Respiration in Health.—As the air-cells at birth are closed, the establishment of respiration is difficult. The air at first penetrates a few pulmonary cells, but gradually more and more are inflated through the forcible inspirations which the crying of the infant produces, till after a variable time respiration becomes easy and complete. If the cry be feeble, and especially if with this feebleness there be considerable congestion of the brain, the result of tedious birth, the full establishment of respiration is in a corresponding degree gradual and slow.

The frequency of the respiration in health should be ascertained in order to determine whether in a given case it be abnormally accelerated. The following table embodies the result of observations which I have made in order to determine the normal frequency of respiration in the first year of life:

Normal Infantile Respirations (number per minute).

	Age.										
	First half hour.	From first half hour to close of first week.		From close of first week to close of first month.		From close of first month to close of third.		Close of third to close of sixth month.		Close of sixth month to close of first year.	
		Awake.	Asleep.	Awake.	Asleep.	Awake.	Asleep.	Awake.	Asleep.	Awake.	Asleep.
Number of observations.	29	28	14	13	13	16	10	25	7	19	6
Extreme number of respirations per minute .	25–104	32–64	40–64	40–96	28–60	32–68	28–52	36–88	24–40	28–64	24–36
Mean number of respirations per minute . . .	48.5	52	52	59	45	51	39	54	33	41	29

As the child advances from the age of one year, the number of respirations per minute gradually diminishes, but through the whole period of childhood it remains greater than in the adult. At the age of five years, when the child is quiet but awake, it is about 27; at the age of ten years, about 22.

Respiration in Disease.—In cerebral diseases the respiration becomes slow, and, if somnolence occur, intermittent and accompanied by sighing. In young infants, in the drowsiness which supervenes when the blood is imperfectly decarbonized, during severe attacks of capillary bronchitis or broncho-pneumonia, respiration is likely to be intermittent.

In inflammatory diseases of the larynx and trachea respiration is but slightly accelerated, and, if there be no obstruction, its rhythm is normal; if there be obstructive disease its rhythm is altered; the inspiratory act is lengthened. In bronchitis respiration is accelerated in proportion to the degree of extension downward of the inflammation. It is in no disease more accelerated than in severe capillary bronchitis.

In pleuritis and pneumonitis the respiration is accelerated in proportion to the extent and acuteness of the inflammation. Inspiration ending abruptly and succeeded by an expiratory moan is a symptom of both pleuritis and pneumonitis in their acute stages. In certain cases of irritative or inflammatory disease of the abdominal organs respiration presents a similar character; it is modified in this manner in consequence of the pain experienced in movements of the diaphragm. Ordinarily, however, in abdominal diseases, respiration is nearly natural.

The cough is an important diagnostic symptom. It is loud and sonorous in spasmodic croup, hoarse or harsh in true croup, clear and distinct in bronchitis, suppressed and painful in the early stages of pneumonitis and pleuritis, convulsive and with more inspirations than expirations in pertussis. A cough due to coexisting bronchitis is one of the first and most constant symptoms of measles. Typhoid and remittent fevers, difficult dentition, intestinal worms, irritating ingesta, and severe burns sometimes give rise to a cough which is nearly dry and painless. Occurring in such diseases, it is sometimes dependent on more or less bronchitis, to which the primary disease has given rise.

A strongly-marked nasal or palatal cry is present in syphilitic ozæna, hypertrophied tonsils, and paralysis of the soft palate. If these can be excluded it indicates retropharyngeal abscess. On one occasion Pollitzer heard this cry in a baby that the mother said was well; but he introduced his finger in the fauces, felt the expected swelling, and by an incision evacuated a considerable amount of pus.

An excessively prolonged, loud-toned expiration, with normal inspiration and without dyspnœa, is, according to Pollitzer, an early symptom of chorea, sometimes preceding all other symptoms. He was once called to a child, apparently well and asleep, in whom this symptom had continued two hours, and was supposed by the mother to indicate croup. Later the ordinary symptoms of chorea appeared. The same author regards a high thoracic, continued sighing inspiration as almost pathognomonic of weak heart and of certain cases of acute fatty heart. Unlike the condition in laryngeal stenosis, while the diaphragm is nearly inactive the accessory muscles of inspiration act strongly. This symptom occurs early, antedating the lividity, pallor, weak pulse, and cold extremities.

A distinct pause after each expiration, ascertained in a quiet room by placing the ear close to the mouth, distinguishes laryngeal catarrh from croup (Pollitzer). Stridulous inspiration usually indicates acute laryngeal catarrh, but I have, in a considerable number of instances, been asked to prescribe for infants with stridulous respiration which commenced early, perhaps in the first or second month, and continued night and day till about the close of the first year, when, in the development of the child, it ceased. It is attended by no dyspnœa or suffering, does not interfere with the nutrition or growth, is not benefited by any known treatment, and it seems that it may exist within physiological limits.

A shrill, loud cry, night after night, in sleep while the child is well in the day-time, is probably due to dreams, and it may be treated by a large dose of quinine at bed-time, but a full dose of the bromide of potassium or sodium is perhaps more likely to give relief. A cry lasting five or ten minutes and occurring several times in the day indicates spasm of the bladder, especially if dysuria be present. It is best treated by belladonna, provided that there be no calculus. A cry during defecation indicates fissure of the anus, and is to be treated by an ointment of zinc and belladonna. A violent and protracted cry, with restlessness, pressing the head on the pillows or breast of the nurse, and frequent carrying of the finger to the ear, indicate otalgia.

CIRCULATORY SYSTEM.

In all ages and countries the pulse has been considered an important symptom, both in diagnosis and prognosis. It aids the practitioner in determining, approximately, not only the character, but the gravity, of diseases. It is somewhat remarkable, from the importance which is attached to the pulse in medical practice, that its natural frequency and its character in infancy are not more accurately known. It is true that eminent observers, as Trousseau and Valleix, have published statistics relating to the infantile pulse in health, but these statistics disagree, and therefore do not afford a reliable standard with which to compare the pulse in disease. Moreover, some published statistics of the pulse possess but little value from the small number of observations; some from the fact that records of the infantile pulse are grouped with those of older children; and others because the state of the infant as regards its activity or emotions is not mentioned.

Pulse in Health.—It is not easy to collect statistics of the pulse during the period of infancy which are entirely free from error, since slight derangements of the system in the infant frequently occur which are not manifested by any marked symptoms, but which produce acceleration of pulse. In collecting the following statistics sources of error, so far as possible, were avoided.

The movements of the heart commonly begin about one-eighth of a minute after birth. They are at first slow, the ventricular contractions not numbering more than eight or ten by the close of the first quarter minute. In the second quarter the cries are vigorous, and the pulse now is rapidly accelerated, rising commonly above 120, and sometimes above 160 beats, per minute. In fifty-seven observations of the pulse in healthy infants during the first half hour of life, after the first quarter of a minute I found that the extremes, with one exception, were 104 and 164—average, 139.

Table of Infantile Pulse in Health.

	AGE.									
	First week.		From close of first week to close of first month.		From close of first month to close of third.		From close of third month to close of sixth.		From close of sixth month to close of first year.	
	Awake. Quiet; moving slightly; nursing.	Asleep.	Awake. Quiet; moving slightly; nursing.	Asleep.	Awake. Quiet; moving slightly; nursing.	Asleep.	Awake. Quiet; moving slightly; nursing.	Asleep.	Awake. Quiet; moving slightly; nursing.	Asleep.
Number of observations . .	22	16	10	10	15	17	25	6	20	3
Extremes . . .	104–152	108–140	124–160	104–144	112–148	104–132	112–146	104–116	112–144	
Mean	126	122	139	118	132	118	129	108	127	109

"M. Ledéberder," says Bouchut, "could only count the pulse in the first minute of life in six children, and he has observed from 72 to 94 pulsations." Valleix estimates the pulse between the ages of two and twenty-one days at 87. Trousseau states that the pulse in the first week of life varies from 78 to 150; and Dr. Gorham's observations are in the main similar to Trousseau's. My observations, as seen from the above table, do not correspond with the assertions of Ledéberder and Valleix. Indeed, if there were no conflicting testimony there would still be a strong presumption that these authors are in error, for we would not suppose that the pulse of the infant, in whom there is greater functional activity both muscular and visceral, would fall so much below that of the fœtus. It is probable from the expression, "could only count the pulse . . . . in six children," that Ledéberder, and perhaps Valleix, counted the pulse in the wrist, which, with exceptional cases, is very difficult and often impossible in the first week of life, and that they missed some of the beats, or, not unlikely, sometimes counted their own pulse. Immediately after birth there is so little force of the ventricular systole, and the extreme arteries, therefore, of the system pulsate so feebly, that neither in the limbs nor at the anterior fontanel can the frequency of the pulse be readily ascertained. It can be readily and accurately ascertained only by auscultation or by placing the hand on the precordial region, or directly after birth by the pulsations in the umbilical cord.

The average pulse of the healthy infant in the first and second months is, according to Trousseau, 137 per minute, 128 from the third to the sixth month, and 120 from the sixth to the twelfth month. It is seen that his observations agree closely with mine as regards infants who are quiet, but awake. One point of interest established by the above statistics is the great diminution in the frequency of the pulse in sleep.

Pulse during or after Active Movements or Great Mental Excitement.

	Age.				
	First week.	Close of first week to close of first month.	Close of first to close of third month.	Close of third to close of sixth month.	Close of sixth month to close of first year.
	140	162	176	132	132
	160	156	152	148	144
	140	140	158	148	152
	152	152	144	144	182
	. .	. .	152	156	198
	. .	. .	180	156	160
Extremes . .	140–160	146–162	144–180	132–156	132–198
Mean. . . .	148	152	160	147	156

It is seen by the above table that by active exercise or great mental excitement the pulse may become as rapid as in grave diseases. There is greater acceleration of pulse from the emotions and from exercise in feeble than in robust children. Obviously, in order to determine to what extent the pulse is accelerated in disease it is necessary that it should be counted during a state of quietude. As the age increases it is less and less influenced emotions and physical exertion; still, during the whole period of such influences do have more or less effect on its frequency.

Pulse in Disease.—Febrile and inflammatory diseases p acceleration of pulse in early life than in maturity. Diseases of system, particularly those of the digestive organs, which do not materially affect the pulse in the adult, often cause acceleration of it in children. The febrile pulse of early life usually has exacerbations in its frequency. These commonly occur in the latter part of the day. Distinct and more or less regular febrile exacerbations and remissions are common in several diseases of early life, some of which are serious, while others involve little danger. Among these diseases may be mentioned difficult dentition, intestinal worms, incipient meningitis, and constipation. An intermittent and irregular pulse is common in fully-developed meningitis and certain other severe organic diseases of the encephalon. It may be due also to disease of the heart, and it also occurs in some children from temporary disturbance of the digestive function. The pulse is slow in compression of the brain and in sclerema of the new-born.

ANIMAL HEAT.

The internal temperature of the body in health is uniform. In 33 infants under the age of seven days M. Roger found the average temperature 98.6° Fahr., while in 25 from four months to fourteen years old it was 99°. The external temperature alone varies in health according to the temperature of the atmosphere.

Elevation of temperature above the normal standard is a sign of inflammatory and febrile diseases. The increase of heat varies according to the nature of the disease and its type. In favorable cases of inflammation and in simple fevers it is not ordinarily more than two or three degrees. The greater the severity and malignancy of inflammatory and febrile diseases the greater the elevation. An elevation of more than six degrees indicates a malady which is likely to prove fatal. It is rare that the temperature, even in fatal cases, rises above 107°. In measles, in the eruptive stage, it is from 101° to 103°; in scarlatina from 102° to 104° if no complication exist. In diphtheria the temperature is elevated at first, but it frequently falls to nearly the normal during the stage of profound toxæmia.

Reduction of the internal temperature is an unfavorable prognostic sign; it is observed a few hours before death in infants who are greatly reduced by certain chronic diseases, as entero-colitis. In these cases the tongue, and even sometimes the breath, communicate to the finger or hand a sensation of coldness.

The importance of thermometric observations as an aid to the diagnosis of children's diseases is within a few years more fully recognized by the profession. Two diseases which in their commencement present very similar symptoms often vary as regards the temperature. Thus, meningitis, presenting in its first stages symptoms very similar to those of typhoid fever, has a lower temperature till an advanced stage, when the amount of heat increases.

DIGESTIVE SYSTEM.

Inspection of the buccal and faucial surfaces discloses some of the most frequent local diseases of infancy, as the various forms of stomatitis, and others which, though not frequent, involve great danger, as gangrene of the mouth, diphtheria, and retro-pharyngeal abscess. Inspection of the tongue aids in determining in many cases whether the disease be pursuing a favorable course or has become asthenic and is exhausting the vital powers.

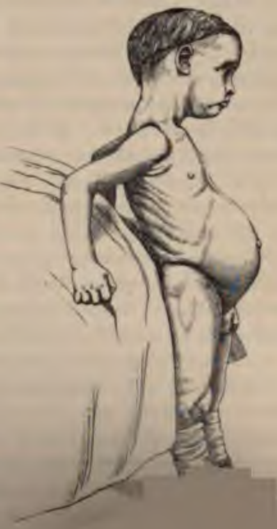
Febrile movements, even when slight, give rise to coating of the tongue and intumescence and distinctness of its follicles. The eruptive fevers are attended by changes upon the buccal and faucial surfaces which possess diagnostic and prognostic value. Hyperæmia of these surfaces appears early in rubeola and scarlatina prior to those phenomena which are justly regarded as pathognomonic. It is therefore often an important sign in the initial period of these diseases when the diagnosis is obscure. The appearance of the fauces in diphtheria and croup, indicating not only the nature of the disease, but its gravity, need only be referred to in this connection.

Inspection of the buccal and faucial surfaces sometimes enables us to form a probable opinion in reference to the nature of diseases which are seated in other parts. In the infant protracted stomatitis is a common accompaniment of chronic diarrhœa, and it indicates its inflammatory nature.

Vomiting is more frequent in infancy than in childhood, and in either period than in adult life. It is common in cerebral affections, and is one of the first symptoms of scarlet fever, and is not uncommon, though less frequent, in the commencement of other essential fevers and of acute inflammations. It is a symptom of indigestion, entero-colitis, cholera infantum, and intussusception; it is common also after the paroxysmal cough of pertussis, and not infrequent in the bronchial inflammations of young infants. In both these diseases it is excited by the muco-purulent matter upon the faucial surface.

Intestinal gas is in part secreted or exhaled from the mucous membrane, as the experiments of Hunter and others have shown, and is in part the product of chemical changes in the food. A certain amount of gas in the intestines is normal; it subserves a useful purpose. An abnormal amount of it is common in various diseases, as indigestion, chronic entero-colitis, peritonitis, typhoid fever. It is a frequent cause of gastralgia and enteralgia in the infant. In scrofulous or feeble infants with impaired muscular tonicity and faulty digestion the abdomen is often habitually more or less distended with gas, which does not, under such circumstances, give rise to pain or other local symptoms; it has significance as showing the general condition of the child.

FIG. 4.



In the rachitic, whose thorax is compressed and liver often enlarged, while the vertebral column is shortened, the abdomen is commonly protuberant. In feeble children, not decidedly rachitic, whose lungs are seldom fully inflated, and whose chests are consequently depressed, the abdomen is also prominent. The accompanying woodcut represents one of these cases presented for treatment at the Out-door Department at Bellevue.

In feeble children who have suffered from repeated and protracted attacks of bronchitis, and whose chest-walls are consequently depressed, a similar abdominal prominence occurs.

Retraction of the abdominal walls is common in meningitis and in many exhausting diseases. Tenesmus is a symptom of intussusception in the infant and of colitis in children.

Much light is thrown on the character of intestinal diseases by the appearance of the stools. Muco-sanguineous stools accompanied by fever are a sign of colitis. Stools containing unmixed blood and not accompanied by fever r
polypus and from purpura hæmorrhagica. Scanty
obstinate constipation, are a symptom of intussusc

The alvine discharges of infants often present a green color; sometimes they have the normal yellow hue when passed from the bowels, but become green on exposure to the air or from reaction of the urine. By the microscope the green coloring matter is seen to occur in small, irregular masses. This green substance has been supposed to be bile. I am convinced that as it occurs in the stools of the infant it is commonly produced by the action of the intestinal secretions on the contents of the intestines; for I have often noticed that the contents in and above the jejunum were yellow, while in and below the ileum their color was green. Probably the green color is due to the formation of biliverdin from the bile which is mixed with the fecal matter.

The green hue may occur from very different causes. It may be due to overfeeding, to the action of cold, to irritating ingesta, to inflammation, etc.; it may be transient, subsiding within a day or two, or it may continue several days. All infants at times have green evacuations, even when they appear in good health.

In the commencement of a large proportion of diarrhœal maladies in infancy the stools give an acid reaction to litmus-paper. This acid, if in considerable quantity, is irritating, increasing the peristaltic movements of the intestines and the functional activity of the intestinal follicles, causing erythema of the skin around the anus, and reacting upon and intensifying the intestinal disease. Hence the indication for the use of antacids in the diarrhœal affections of infancy.

The presence of intestinal worms and the species may be ascertained by microscopic examination of the stools of a child which is affected with these entozoa. The stools contain ova, which differ in size and shape according to the species of worm.

NERVOUS SYSTEM.

PAIN.—This symptom affords important aid to the physician in determining the seat and nature of the diseases of children. Pain in the head may occur in them from coryza involving the frontal sinuses, or from febrile movement in the commencement of an essential fever, or from inflammation of one of the organs of the trunk. Produced by such a cause, it abates in two or three days. If it be protracted, whether constant or intermittent, it is in many cases not neuralgic, as it so often is in the adult, but is due to organic disease of the brain or meninges. Complaint, therefore, of headache in a child, without any apparent general cause or local cause external to the cranium, should awaken solicitude, and if it be protracted the physician should examine carefully in reference to the presence of a cerebral or meningeal disease. Mild frontal headache continuing for weeks or months is neuralgic and due to anæmia. It is increased by pressure over the occiput and upper cervical vertebræ.

Grave thoracic or abdominal inflammations in the adult are almost always attended by a corresponding amount of pain and tenderness, but in children these symptoms are often absent, or when present are frequently not commensurate with the amount of disease. Thus, entero-colitis of nursing infants is, in a large proportion of instances, almost free from these symptoms.

Pain in the chest or abdomen, occasional or constant, continuing for weeks or months, with fever, and unattended by thoracic or abdominal disease, indicates caries of the vertebræ. Its most common seat is the epigastric, umbilical, or hypochondriac region. It is a neuralgia due to irritation of the sensitive root of one or more of the spinal nerves. It is a very important symptom to the diagnostician, showing the nature of the disease, which in its incipiency is so obscure. Pain in the leg, especially the inside of the knee, is of a similar character, indicating disease of the hip-joint.

Children with certain acute febrile and inflammatory diseases sometimes have hyperæsthesia of portions of the surface; it is especially marked upon the anterior aspect of the trunk. The physician might be misled into the belief that the tenderness occurred over the seat of the disease and indicated an inflammation; but the pain of hyperæsthesia can be diagnosticated from that of inflammation by the fact that it is so extensive, is less on firm than light pressure, and is especially observed upon the inner surface of the thighs. The symptoms pertaining to the nervous system occurring in the various diseases treated of in this book will be fully described in connection with those diseases, and therefore need not detain us in this connection.

CHAPTER XI.

THERAPEUTICS.

THE young practitioner is often perplexed in deciding exactly what dose of the stronger and more dangerous medicinal agents to prescribe for a child. A practical rule, which holds good for many medicines, has been proposed by Dr. Cowling, as follows: "The proportional dose for any age under adult life is represented by the number of the following birthday divided by twenty-four." This rule is inadmissible for infants under the age of six months, but will apply for those that are older for the use of a large number of medicines. Another rule, proposed by another British physician, Professor Clarke, is based on differences in weight of children and adults: The adult dose is represented by 150. The dose of a child is determined by dividing its weight in pounds by 150. But it is an interesting fact, and one of practical importance, that children bear and often require, in order to obtain the desired effect, a much larger proportionate dose of certain agents than adults. This is partly attributable to the active elimination in childhood. Belladonna is notably one of the agents which children tolerate, and it may be added that some children can take a much larger dose of it than others without producing the physiological effects. Thus, recently I increased gradually the tincture of belladonna to twelve drops for a child of four years without producing the usual efflorescence; and Farquharson says "the dose . . . . I have pushed in a child of ten suffering from incontinence of urine to f℥ij (British Pharmacop.) with good effect and the development of mild forms of physiological disturbance." Arsenic is also better tolerated by children than adults. An infant of six months can take two-drop doses of Fowler's solution three times daily without ill effect. Prussic acid, strychnia, iron, ipecacuanha, and alcohol are also required in larger proportionate doses in childhood than is indicated by the rule either of Dr. Cowling or Professor Clarke.

When practicable, medicines should be given in the liquid form. Those not soluble may often be given in suspension in some vehicle which in great part disguises the taste. A good vehicle for the bitter vegetables, as the salts of quinia, is the elixir adjuvans of Caswell and Hazard.

The elixir adjuvans may also be advantageously employed in the administration of many other medicines apart from those which are repulsive on account of their bitterness. It holds them in suspensi [illegible] y have a greater specific gravity than the elixir, it is nece [illegible] thoroughly before using it. The elixir taraxaci comp. is another good vehicle for the bitter vegetables, but perhaps their bitterness, especially that of quinine, is more effectually disguised by the syr. yerbæ santæ comp. than by any other vehicle. I am sure, from many observations, that unpleasant doses are liable to be wasted to a greater or less extent, and the repugnance of children to medicines employed has induced many a parent to seek other and less disagreeable modes of treatment. Chemistry has greatly aided the therapeutics of childhood, in that it has enabled us in so many instances to prescribe the active principles in place of the large, nauseous doses formerly employed.

PART II.

DISEASES OF THE NEWLY-BORN.

CHAPTER I.

MALFORMATIONS.

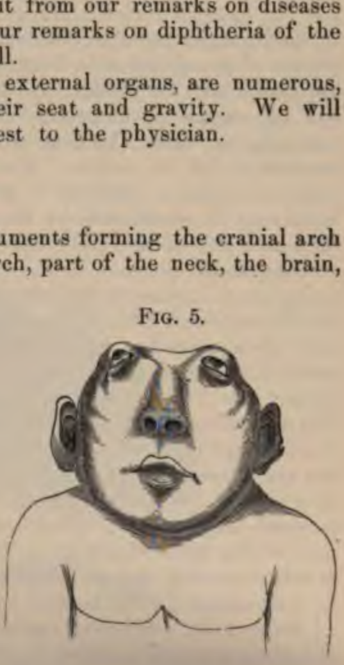
ASPHYXIA, or apnœa neonatorum, is the first in time in the long catalogue of human maladies. It requires and receives the immediate attention of the accoucheur, and is treated of fully in books relating to midwifery. We will therefore omit the consideration of it from our remarks on diseases of the newly-born. We will also postpone our remarks on diphtheria of the newly-born until we treat of diphtheria in full.

The malformations, both of internal and external organs, are numerous, and they require attention according to their seat and gravity. We will describe only such as are of especial interest to the physician.

ACRANIA.

In this malformation the bones and integuments forming the cranial arch are absent. In extreme cases the cranial arch, part of the neck, the brain, and the medulla oblongata are lacking. A vascular mass lies on the exposed base of the skull, often resembling the placenta in appearance. It consists of connective tissue in addition to the vessels. It is the representative of the cerebral meninges, and is continuous below with the spinal meninges. Its smooth surface is the analogue of the arachnoid. The sensation which is imparted to the finger of the accoucheur pressed upon it is very similar to that produced by a placenta. In some specimens small portions of cerebral matter are found among the vessels of this tumor, but they are so disconnected and isolated that they do not perform in any way the functions of a brain. Occasionally the vascular tumor is absent and the medulla—or, if this be absent, the upper extremity of the spine—is expos

FIG. 5.



The absence of the brain and cranial arch gives a remar

The frontal, parietal, and occipital bones are absent, except those portions which are near the base of the cranium. These portions are very thick and closely united, as if there were the usual amount of osseous substance, but instead of expanding into the arch it had collected in an irregular mass at the base of the cranium. The eyes are prominent, the neck thick and short, while the body and limbs are ordinarily well developed. The physiognomy has a frog-like appearance. Those portions of the cranial nerves which lie without the cranium are well developed, although the intracranial portions are absent. In this anomaly of acrania and anencephalus a twin is often present which in some manner has interfered with the normal development of the fœtus.

Symptoms.—If the medulla be absent, of course viability is impossible. If it be present, respiration may occur for a time, but is irregular. The monster may be made to cry, but the cry is a reflex phenomenon resembling a sob or hiccough. It may nurse, its digestive function is well performed, and regular urinary and fecal evacuations occur. There is a tendency in such monsters to convulsions.. Blowing upon them and pressure upon the projecting medulla, if this be present, frequently produce this result.

Prognosis.—Fortunately, non-viability or speedy death is the result. If the medulla be present and respiration and circulation be established, nevertheless death usually results within two or three days, and with scarcely an exception within ten days. Convulsions sooner or later supervene, ending in fatal coma.

Incomplete Brain.

Deficiencies occur in the formation of the brain, so that there are various grades of incompleteness between the normal and absent brain. Portions of the brain may be absent or rudimentary, while the remainder of the organ has its normal development. The deficiencies are usually in the cerebral hemispheres, while the base of the brain, which is important for the maintenance of life, is perfect. Both hemispheres may be absent, or one absent while the other is complete or small and rudimentary. Incompleteness of the brain may be manifested by the small size of the cranium and the retreating forehead, but occasionally the cranium has its normal shape and size, on account of an increase in the cerebro-spinal fluid proportionate to the deficiency in the cerebral development. Such a case was under observation in the Nursery and Child's Hospital in 1862. She took the breast and received food when placed in her mouth, but without apparent relish. She was supposed for a time to be blind, as she was apparently unconscious of objects around her. There was a total absence of intellectual manifestations. The size and shape of the head did not differ materially from the normal, but the frontal bone lay a little lower than the parietal. She died of entero-colitis at the age of ten months, and at the autopsy a sac containing about three-fourths of a pint of nearly transparent cerebro-spinal liquid occupied the site of the cerebral hemispheres. Rudimentary hemispheres were found constituting a part of the walls of the sac. The weight of the brain after being a few days in dilute alcohol was 6¼ ounces. In this case the fluid was nearly sufficient to compensate for the lack of brain-substance.

Symptoms.—Since in cases of imperfect brain in which life is preserved the arrest of development is usually in the cerebral hemispheres, the symptoms which indicate the deficiency relate chiefly to the degree of mental endowment. If the hemispheres are partially developed, there is a degree of intelligence proportionate to the amount of the cerebral substance present. If the arrest of development be on one side, there may be no appreciable lack of intelligence or mental activity, since one hemisphere may perform the functions of both.

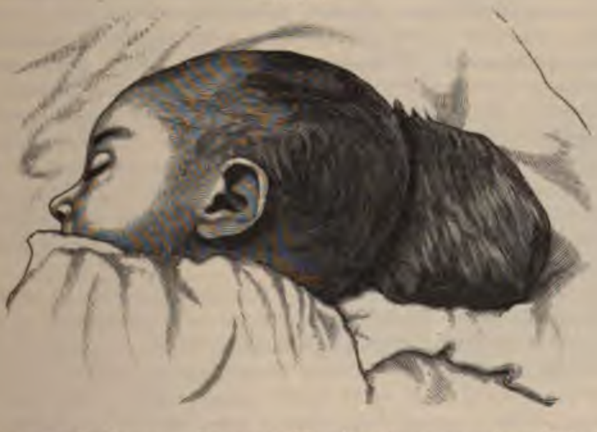
PROGNOSIS.—This as regards life depends on the seat of the arrested development. If the cerebral hemispheres be deficient, the child may live and thrive, though idiotic; but if the arrest of development be at the base of the brain, which controls the functions of animal life and gives origin to nerves which are essential to the physical well-being, life is uncertain and probably will be short. It is evident that therapeutic measures cannot remedy a congenital deficiency in the brain, but the patient, philanthropic teacher can impart some instruction to the idiotic, and occasionally improve in a measure their lamentable condition.

MENINGOCELE, ENCEPHALOCELE, HYDRENCEPHALOCELE.

This is the analogue of spina bifida. An opening exists at some point in the skull, through which the meninges, or meninges with brain-substance, protrude. The deficiency is congenital, and the tumor exists at birth or is noticed soon after. It is termed a meningocele if only meninges protrude; an encephalocele if it contain brain-substance in addition to the meninges; and a hydrencephalocele if, in addition to the brain-substance, the mass contain liquid in its interior.

The most frequent site of these tumors is the occiput, where the protrusion occurs from an opening in or at the edge of the occipital bone. The next most frequent location is the naso-frontal region. Rarely they occur upon the temporal, parietal, and basilar portions of the skull. Ordinarily, the opening in the occipital bone through which the protrusion takes place is at the median line, or near it, anterior or posterior to the occipital protuberance. The opening, if in the anterior part of the occipital bone, may extend to the fontanel: if in the posterior part, it may extend to the foramen magnum. It may connect posteriorly through the foramen magnum with the cleft of a spina bifida. If the opening in the occipital bone be large, the tumor is also usually large. Prescott Hewitt cites a case in which it extended to the loins; but so large a mass consists mostly of liquid and is rare. An occipital encephalocele contains brain-substance from the cerebellum or posterior cerebral lobes or from both. If the tumor upon the occiput be a hydrencephalocele, the liquid is from the posterior cornu of a distended

FIG. 6.



lateral ventricle or from a distended and dropsical fourth ventricle, and it occupies the interior of the tumor, the brain-substance surrounding it.

If the tumor be in the frontal region, the protrusion usually occurs between the cribriform plate of the ethmoid bone and the frontal bone, and it appears externally between the nasal and the frontal bones. Exceptionally, the point of protrusion is between the lateral halves of the frontal bone. The anterior lobe or lobes of the cerebrum protrude in an encephalocele in this location; if the tumor be a hydrencephalocele, the liquid is derived from the anterior cornua of the lateral ventricles. As a rule the frontal are smaller than the occipital tumors, and the skin covering them is more frequently red and vascular, so as to present the appearance of vascular tumors.

Exceptionally, the protrusion occurs from a fontanel or from the line of one of the sutures, so that it is seated upon the side of the skull. Cases are also on record in which the opening existed between the ethmoid and sphenoid bones, through the sphenoid, or between the sphenoid and its greater wing. Tumors in this location appear in the pharynx or mouth, or enter an orbit, displacing the eye, or protrude through the spheno-maxillary fissure. The tumor having this site is usually an encephalocele or hydrencephalocele, the meningocele being rare. Its walls consist of skin, dura mater, and arachnoid, with intervening connective tissue. If the protrusion be at the base of the brain, of course the external covering of skin is lacking. In other locations the skin constitutes the external coat, and it may be tense and scantily covered with hair, or red and vascular. The interior of the sac is lined by the arachnoid and dura mater. These tumors, whatever the exact character of their interior, can be more or less reduced by compression, with a return of a part of their contents into the cranial cavity; but such compression usually produces cerebral symptoms, as stupor or fretfulness, vomiting, and strabismus. The following characteristics of the three forms of these tumors aid in their differential diagnosis:

Meningocele.—Small at first, and remaining either small or of moderate size, fluctuation distinct, pedunculated, translucent, no pulsation, tense on forced expiration, reducible.

Encephalocele.—Small, base wide, no fluctuation, opaque, or sometimes translucent at the apex, distinct pulsation, enlargement by forced expiration, partly reducible, cerebral symptoms occurring from compression.

Hydrencephalocele.—Tumor usually large, often pendulous, and its surface lobulated, pedunculated, fluctuating; portions translucent; pulsation absent or rare. It is seldom affected by pressure, and the patient is likely to be microcephalic from the escape of brain-substance external to the cranium.

These protrusions have been mistaken for various cysts, as cephalæmatoma, serous and sebaceous cysts, abscesses, vascular growths, and polypi. The fact that such errors in diagnosis have been made by various surgeons shows the importance of a thorough and careful examination before operative measures are employed.

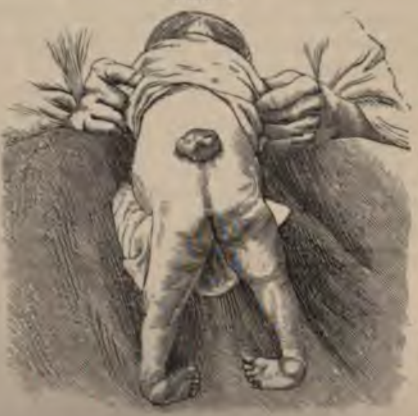
Most patients with this deformity die in a few weeks or months. The prognosis depends on the size of the aperture and the amount of protrusion. It is most unfavorable in hydrencephalocele, which is usually attended by deficiency of brain within the cranium, sometimes to such an extent that the patient is microcephalic and early death unavoidable. The hydrencephalic tumor is very liable to grow, and, after a time, rupture, causing immediate death in convulsions or collapse. In meningocele, if the aperture be small, the tumor may remain small, become isolated from the cranial cavity, and the patient may live for years. But of the three forms of the tumor, encephalocele is regarded as the most favorable, since it is usually small, and patients with it not infrequently live many years. The prognosis in these tumors is very similar to that in spina bifida, which varies according to size of the aperture and the amount and character of the protrusion.

TREATMENT.—Those who have had experience with these tumors concur for the most part in the opinion that surgical interference should not be resorted to unless rupture be imminent. The mass should be protected from abrasion, and that degree of pressure should be employed which can be tolerated without producing cerebral symptoms. It is proper to draw off the liquid of a meningocele if it be distended and likely to rupture, and the tapping may be repeated, with, exceptionally, the result of a cure or of rendering the tumor stationary. Mr. Holmes has injected the tumor with two drachms of a mixture consisting of one part of tincture of iodine and two of water, allowing it to remain: and Mr. Annandale has ligatured the mass in one instance, and effected a cure. In encephalocele and hydrencephalocele support and moderate pressure should be employed, and in the latter some of the liquid should be removed by a small trocar if rupture be threatening.

SPINA BIFIDA.

This is one of the most common of the malformations. In its severe form it is from its nature incurable, admitting only of palliative treatment, while in its milder forms it may be cured or so relieved that it does not endanger life. The term spina bifida is applied to a hernia of the spinal meninges, which produces a rounded tumor, situated posteriorly over the spine in the median line. It is due to the congenital absence or incompleteness of one or more of the arches of the vertebræ. In exceptional instances the arch is said to be complete at birth; but the lateral portions separate and are pressed outward during the first weeks of life. The tumor contains cerebro-spinal fluid, and unless it be small and its walls unusually thick fluctuation may be detected in it. When the child cries the tumor enlarges, and it is reduced by compression, the fluid re-entering the spinal canal. If the tumor be large, its complete subsidence by pressure often produces dangerous cerebral symptoms. Spina bifida is the analogue of hydrocephalus, and the two often coexist. If we compress the hydrocephalic head the spinal tumor enlarges, and *vice versâ*. Club-foot is another not infrequent complication. In the case which is represented in the accompanying wood-cut (Fig. 7), hydrocephalus, spina bifida, and club-foot coexisted. The child was brought to the children's class in the Out-door Department at Bellevue, and after a few visits I lost sight of it. It probably died soon after, since the tumor, over which the cuticle was wanting, presented a deep red appearance as if inflamed, so that ulceration and escape of the fluid seemed near at hand. There is ordinarily but one spina bi [illegible] he common seat of which is the lumbar region, but occasionally [illegible] present. If the aperture through which the tumor pr [illegible] usually pedunculated, but if large it is sessile. In [illegible] ered with skin, which may be normal or somewhat in

FIG. 7.



skin is absent over the entire tumor or its most prominent part, and the dura mater or the connective tissue lying directly over the dura mater is exposed, and is liable to inflammation from friction. If the walls of the tumor be thin, the liquid may transude in drops, and they are liable to give way by ulceration or rupture. Sudden escape of the liquid and collapse of the spina bifida involve great danger, for convulsions, coma, and death are the common result.

The relation of the spinal cord or nerves, or of the cauda equina, to the tumor is a matter of great importance. In many patients the adjacent portion of the cord or cauda equina is deflected through the aperture, and lies against the anterior of the sac. Spinal nerves also not infrequently lie within the sac, some returning into the spinal canal, and others passing through the walls of the sac to their points of distribution. Those which are deflected into the tumor and return into the canal obviously lie lowest. In the most favorable cases—to wit, those with a small aperture or small tumor or a narrow and long peduncle—neither the cord, cauda equina, nor nerves lie within the sac. It is important to the practitioner to bear in mind that in all probability, unless under the favorable anatomical circumstances stated above, the sac contains nervous elements. In rare instances the liquid, instead of lying externally to the cord, lies within its central canal. The substance of the cord then becomes distended, and it encloses the liquid like a delicate sac, just as the hemispheres of the brain are unfolded and expanded in the common form of congenital hydrocephalus. As might be expected from the anatomical characters of the more serious forms of spina bifida, paralysis, more or less complete, of the vesical and rectal muscular fibres and paraplegia sometimes occur, in which event the fatal issue is probably not far distant.

Diagnosis.—This is easy in ordinary cases. The congenital nature of the tumor and the bony edge of the aperture, appreciable to the touch, suffice in ordinary cases to establish the diagnosis. The diminution of the tumor by pressure, and its enlargement when the child cries, are important diagnostic signs. There are various lumbo-sacral tumors located in the median line from which it is important that spina bifida should be diagnosticated. Sometimes a cyst occurs in this situation which was originally a spina bifida, but obliteration of the canal in the pedicle occurred, just as the canal connecting a hydrocele with the abdominal cavity closes. Solid congenital tumors sometimes also grow in the same situation, among which, as most common, may be mentioned fatty tumors and tumors containing fœtal remains. The most common seat of tumors which enclose fœtal remains is at the point where spina bifida ordinarily occurs. Physicians have erred in mistaking these tumors, as well as those which consist of fat, for spina bifida; but a mistake in diagnosis can only occur through haste or carelessness of examination.

Prognosis.—This is in most instances unfavorable. Ordinarily the tumor increases slowly, and finally the sac gives way by ulceration or rupture; the liquid escapes, and death occurs in convulsions and coma; or, if the escape of the liquid be prevented by pressure and the aperture closes, a second rupture is probable, with a fatal result. In other cases the tumor may not rupture, but the cord is softened or it is injured by being bent, so that paraplegia results, and death after a time occurs in a state of emaciation. Rarely the tumor may shrivel by absorption of the liquid, and the disease is cured, or so nearly cured that it gives no inconvenience and the patient lives for years. In other rare instances the tumor may remain without any material change and without giving rise to symptoms. The spina bifida being small and covered with skin, and the aperture leading from it into the spinal canal being also small, the patient lives through the natural period of life with little inconvenience.

TREATMENT.—It is evident, from what has been stated, that no fixed rule can be laid down for the treatment of spina bifida. In the most favorable cases, in which no symptoms occur and there is no indication that the tumor will undergo any unfavorable change, surgical treatment is not required, except the application of a soft pad to support the tumor, so as to prevent its injury by friction. Indications which justify active surgical interference are growth of tumor, absence of skin from it, with tension of the parietes, so that an early rupture is inevitable, and the occurrence of dangerous nervous symptoms, as convulsions or paraplegia.

From the nature of spina bifida it is evident that operations upon it must be conducted with caution. The usual presence of the spinal cord in the pedicle and in the sac forbids ligation and excision, and renders hazardous attempts to obliterate the sac by producing inflammation within it. A safe mode of treatment, but not the most efficient, is to puncture the sac and withdraw a portion of the liquid by a grooved needle or hypodermic syringe. A soft pad should then be applied to produce gentle compression. If no unfavorable symptoms occur, the puncture may be repeated after a day or two. This operation has been employed with a satisfactory result by Sir Astley Cooper among others; but, simple as it is, it is not devoid of danger, for the removal of the liquid, if carried beyond a certain point, may produce dangerous nervous symptoms, especially convulsions. In performing the operation the puncture should never be made in the median line, on account of the danger of wounding the cord, which lies against the median portion of the sac. The veins, also, should be avoided.

Another mode of treatment is by iodine injections. They are preferable to other methods if the neck be long and pedunculated, so as to be easily compressed. If the tumor be sessile, and the aperture into the spinal canal be free, these injections involve great danger, and are not to be recommended; for more or less of the solution will inevitably enter the spinal canal and give rise to spinal meningitis. Iodine injections have been employed with success by Professor Brainard of Chicago, who states that he "perfectly and permanently cured" three of seven cases; and by Velpeau of Paris, by whose method five in ten operations were successful, and by many others. Professor Brainard withdrew some of the liquid contents, and then injected half an ounce of water containing 2½ grains of iodine and 7½ grains of iodide of potassium. In a few seconds this was allowed to flow out, and the sac was then washed out with tepid water. Then a portion of the cerebro-spinal fluid, which had been kept warm, was returned into the sac. When he had withdrawn six ounces of this fluid he returned two ounces. In employing the iodine or any other irritating injection, it is necessary to compress the pedicle, so that the liquid does not enter the spinal canal. Velpeau employed one part of iodine, one of iodide of potassium, and ten of distilled water.

During a debate in the Société de Chirurgie, M. Debont recommended the evacuation of only a little of the fluid. and the injection of two or three drops of the tincture of iodine diluted with an equal quantity of water. T. Smith,[1] by the injection of one drop of the tincture, produced an amount of inflammation which nearly obliterated the sac. Since statistics show so good a result of iodine injections, this mode of treatment seems preferable to any other for certain cases, and as one drop has produced general inflammation of the sac and nearly obliterated it, it seems safest and best to begin with so small a quantity.

If there be reason to believe, from the small size of the orifice and other anatomical characters, that neither the cord, cauda equina, nor any of the spinal nerves lie within the sac, it may be thought best to remove the tumor. It has, indeed, been proposed to open the tumor, immersed under warm water, sufficiently to observe the relation of the nervous elements, and to press them back gently into the canal if they lie within the sac. If it be decided to remove the spina bifida, a clamp or elastic band is placed around the pedicle so snugly as to cause firm adhesion of the walls of the pedicle, and excite sufficient inflammation in them to produce agglutination, but without causing strangulation or suppuration.

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[1] *Holmes's Surg. Dis. of Children.*

After a time, perhaps two or three days, when it is evident that agglutination has occurred from the fact that the liquid cannot be returned within the spinal canal by compressing the sac, the tumor may be removed by the knife or écraseur. Statistics do not show so favorable a result of this operation as of the iodine treatment, and the reason is obvious, for it is only in exceptional cases that the tumor can be removed without injury to the nervous tissue, and incision of a portion of the cord or of important nerves either produces death or a condition to which death would be a relief.

Spina bifida has also been treated by opening the sac on its side, pressing back the spinal cord or its nerves into the spinal canal, uniting the edges of the wound, and then applying pressure to prevent protrusion, but the result has not been favorable. Treatment by simple puncture, followed by compression, and if it fail, as it probably will, the cautious use of iodine injections, is the preferable mode of treating ordinary cases of spina bifida which require surgical interference.

CONGENITAL ABNORMALITIES IN THE CIRCULATORY SYSTEM.

Rarely the position of the heart is abnormal, and the most common malposition is its location on the right side of the chest (dextro-cardia). This occurs with or without misplacement of other organs. In cases of dextrocardia the liver usually, says Niemeyer, occupies the left hypochondrium, and the spleen the right. In this misplacement of the heart the aorta ordinarily crosses the right bronchus and passes along the right side of the vertebræ, but occasionally it crosses the spine and lies in its usual position on the left side of the vertebræ. The heart in this malposition is sometimes imperfect and sometimes well formed. In mesocardia the heart is situated nearer the median line than usual, corresponding in this respect with the position which it occupies in the first months of fœtal life. A rare malposition is the location of the heart outside the thoracic cavity (ectocardia extrathoracica)—a condition accompanied by, and perhaps due to, deficiency in the sternum or sternum and ribs. In other instances equally rare a part of the diaphragm has been deficient, and the heart has lain in the abdomen; and in other instances still it has been located at the base of the neck. Breschet and others have cited examples of these various forms of ectopia cordis.

SYMPTOMS—PROGNOSIS.—If the heart be well formed and complete, its abnormal position within the thorax may not give rise to symptoms, and is not incompatible with prolonged life. If it be located without the thoracic cavity or be within the cavity and be defective, early death is probable.

MALFORMATIONS OF THE HEART.

Malformation of the heart occurs—1st, from arrested development early in fœtal life, so that the organ remains rudimentary; 2d, from arrested development at a more advanced stage, when the cavities, septa, and vessels, though incomplete, are partially formed; 3d, from malposition of the parts of the heart or of the vessels in immediate relation with the heart. The cause of malformation in the heart and the vessels pertaining to it is obscure. It is supposed sometimes to be a myocarditis or endocarditis, which causes the arrest of growth or abnormal development.

Perhaps strong mental excitement sometimes has a causal relation, whatever may be its modus operandi, just as it causes external malformations. In a case related by Dr. Peacock[1] the mother stated that when pregnant she was greatly frightened by the appearance of a man who was dying of asthma. In another instance the only assignable cause was fright of the mother at seeing a child killed, and she did not recover from the shock;[2] in another case the mother was greatly alarmed at the fifth month of gestation,[3] and in the fourth instance the mother four or five months before her confinement was greatly frightened by her husband, who was insane, standing over her two hours with a loaded pistol.[4] But these are exceptional instances. In a large majority of cases of malformation of the heart inquiry fails to elicit any unusual mental excitement of the mothers during their gestation.

Occasionally the malformation appears to be due to some vice or taint in the system of one or both parents. Thus in a case quoted in the *Gazette médicale* for Dec. 28, 1850, the mother, who had rachitis in early life, lost five children soon after their birth, all of whom had lividity as the most prominent symptom. Persistent lividity in the newly-born indicates, almost without exception, malformation at the centre of circulation. In the history of a case which was communicated to Cooper by Farre "vices of conformation of the heart appear to have been inherent in the family. Of 12 infants only 4 survived," the death of the 8 being apparently from cardiac malformation. A patient treated by Mr. Leonard was the sixth who had died at about the same age with symptoms of cyanosis. Ordinarily, however, infants who have cardiac malformations, as indicated by the cyanotic hue, belong to healthy families; neither parents, brothers, nor sisters exhibit any taint of system which could sustain a causal relation to any form of malformation.

The opinion is expressed by Gintrac that the number affected with cardiac malformation, as indicated by cyanosis, to the entire population varies in different countries. It is probable that its occurrence is not greatly, if at all, affected by the nationality, but it is certainly dependent to a considerable extent on the condition of society. It appears from statistics to be less frequent in a community in comfortable circumstances and engaged in quiet and wholesome occupations than in those whose occupations produce undue mental excitement and worriment and irregularities in the mode of life. Pure air and outdoor exercise, plain, nutritious diet, freedom from cares and anxieties—in fine, causes which promote the physical well-being—diminish the liability to a malformed and cyanotic offspring; and, on the other hand, impure air, improper and insufficient diet, grief, etc. increase the percentage of cardiac malformations and cyanosis. Hence the blue disease is rare in the rural districts and comparatively frequent in the cities, especially in a large city like New York, which contains a numerous indigent and careworn population, living from year to year in the midst of agencies which operate stealthily but certainly to enervate the system and undermine the health.

These remarks are abundantly substantiated by statistics. In New York City, during the period of six years, 1 death resulted from cyanosis to 436 deaths from all causes, and in Brooklyn the proportion estimated for two years was about the same. On the other hand, in the State of Kentucky, which contains few large cities, there was, during a period of five years, 1 death from malformation of the heart to 2469 from all causes. In the State of South Carolina, for three years, 1 death resulted from cyanosis to 5018 from all causes. In the State of Massachusetts, for two years, there was 1 death from cyanosis to 1136 from all causes, and two-thirds of the cyanotic cases occurred in the counties of Suffolk, Essex, and Worcester, which contain large cities, In London 1 death occurred from cyanosis to 755 from all causes during a period of three years. On the other hand, in England, including the city of London, there was, for the ten years ending with 1857, 1 death from cyanosis to 1589 from all causes; and in the rural districts of Monmouth and Wales only 1 death occurred from cyanosis to 5578 deaths from all causes during a period of two years.

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[1] *Malformations of the Heart*, p. 57.

[2] *Ibid.*, p. 37.

[3] *Ibid.*, p. 41.

[4] *Ibid.*, p. 43.

Malformations of the heart derive their seriousness and importance from the fact that the heart is the central organ of circulation, so that when from malformation it is inadequate to perform fully its function, not only is the nutrition seriously interfered with, but the flow of blood through the lungs is insufficient. The blood is not properly oxygenated, and it is overcharged with carbonic acid, which imparts to it the deeply venous or livid color. Cyanosis therefore, as indicative of an imperfect heart, a persistent defect in the circulation, and a permanently abnormal state of the blood, is an important disease.

CYANOSIS.

As stated above, the cause of cyanosis when occurring in infants is at the centre of circulation, and is a malformation with very few exceptions. The diagnosis can be made with certainty if there have been no symptoms indicating an antecedent disease. In rare instances in infants above the age of five or six months lividity of the surface occurs from *disease* in the lungs, such as extensive emphysema, a pleuritic exudation compressing both lungs, caries of the vertebræ, with consequent depression of the ribs so as to prevent proper inflation of the lungs. But such causes do not exist or are very rare under the age of six months.

The blue disease, being so manifest, attracted attention at an early age. It appears from the remarks of Boerhaave that the common people believed that the cyanotic were possessed by evil spirits.[1] It was evidently impossible to understand its cause and nature prior to the discovery of Harvey in the seventeenth century, and most of the exact or scientific knowledge possessed by the profession in reference to the etiology and nature of cyanosis has been achieved since the present century commenced. Boerhaave and Vieussens had observed cases and propounded theories in reference to it, but the knowledge of physicians concerning it remained vague and indefinite. No better idea can be given of the prevailing ignorance in reference to cyanosis, even after the present century commenced, than by quoting from a case related by Ribes in 1814.[2] The patient had some time previously received an injury of the finger. "Many physicians of Amsterdam," says he, "were at different times consulted on the subject of this affection, no one of whom understood its true cause, its essential character. One considered it as partaking of the nature of epilepsy, and caused by the irritation in the nervous system which the wound in the finger had produced. Others attributed it to the presence of intestinal worms. Some physicians pronounced it an injury to the liver or spleen. Many held it to be a scorbutic affection. One only believed it to be the result of an unknown organic disease." In the present century numerous carefully observed cases of cyanosis published in the medical journals, and the writings of Seiler, Louis, Bouillaud, Farre, Chevers, Peacock, Marston, Stillé, and others, have contributed to a better understanding of the nature and anatomical characters of cyanosis.

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[1] *Diseases of the Humors.*

[2] *Bull. de la Fac. de Méd.*, 1815.

SEX.—Whatever may be the explanation, the following statistics show an excess of male infants affected with cyanosis:

TABLE 1.

180 cases	collated by Aberle	two-thirds males.
44 "	" " Gintrac	28 males, 16 females.
41 "	" " Stillé	21 " 10 "
134 "	" " J. Lewis Smith .	78 " 56 "

TABLE 2.—*Deaths from Cyanosis.*

	Males.	Females.
In London, England, in two years	418	273
In New York City, in five years	117	90

TIME OF COMMENCEMENT.—It is an interesting and somewhat remarkable fact that cyanosis, though dependent on a malformation, does not always commence at birth, or at least does not exist in degree sufficient to produce the cyanotic hue till some time has elapsed after birth. In 138 of the cases of cyanosis which I have collected the time at which lividity was first observed is stated as follows: In 97 it was within the first week, and generally within a few hours of birth. In the remaining 41 cases it commenced as follows:

In 3 at 2 weeks.
" 1 " 3 "
" 2 " 1 month.
" 7 from 1 to 2 months.
" 5 " 2 " 6 "
" 5 " 6 " 12 "
" 3 " 1 year to 2 years.

In 6 from 2 years to 5 years.
" 1 " 5 " " 10 "
" 6 " 10 " " 20 "
" 1 " 20 " " 40 "
" 1 over 40 years.

41, total.

In these 41 cases, in which blueness did not occur till after the age of one week, if the patient were less than two years old when it commenced there was frequently no obvious exciting cause, but above this age, with three exceptions, such a cause is known to have been present. It is interesting to observe how trivial the exciting cause frequently is, and equally interesting to note how long patients have enjoyed good health, not having the least lividity, although the anatomical vice to which the final development of cyanosis was due had existed from birth.

Dr. Theophilus Thompson relates[1] the history of a lady, thirty-eight years old, who was well till an attack of Asiatic cholera, after which her health was permanently impaired. Two years before her death she passed through a course of fever, and from this time was cyanotic. In the *Philadelphia Medical Examiner*, June, 1850, Dr. Waters relates a case in which cyanosis began at the age of six years in an attack of measles. In a case published by Mr. Napper in the *London Medical Gazette*, 1841, the child fell at the age of six months, and from this time had cyanosis. A female whose history is given by Prof. Tommasini of Bologna, and quoted by Bouillaud, became cyanotic at the age of twenty-five in consequence of difficult parturition, In the *London Lancet*, 1842, Mr. Stedman relates a case in which cyanosis began at the age of ten weeks in an attack of convulsions. In the *American Journal of Medical Sciences*, in 1847, Dr. John P. Harrison published the history of a baker, twenty years old, in whom cyanosis began five years previously after great effort in carrying wood. Louis and Bouillaud quote from M. Caillot the case of a child who became cyanotic at the age of two months in an attack of whooping cough. Louis also narrates a case in which whooping cough had the same effect at the age of twelve years. Ribes treated a child in whom the blue disease began at the age of three years from a severe contusion of the fingers. In a case by Marx it commenced at the age of ten months from a blow on the back inflicted by the mother. In the *Medical Times and Gazette*, for 1855, Mr. Speer gives the history of a female who at the age of thirteen years was put in a place requiring considerable exertion, and from this time was cyanotic. A patient whose case was related by Cherrier fell into a deep ditch in the winter season, and immediately after had a low fever, from which the blue disease commenced. In a case published by Tacconus the exciting cause was believed to be fright in consequence of a fall from a great height, and in another, related by Bouillaud, it was a blow received on the epigastrium after the patient had passed the age of fifty years. Similar cases are related by Mayo and Peacock.

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[1] *Medico-Chir. Trans.*, vol. xxv.

It will be seen that the exciting cause of cyanosis is usually such as produces a profound impression on the system and affects the action of the heart. Precisely in what way it operates to develop the disease has not been satisfactorily explained. Mr. Mayo conjectures that in the case related by him there was previously some compensation which ceased or became inadequate in consequence of some change produced in the economy. Although cyanosis may not appear for months or even years, there is rarely improvement when it is once established. Appearances of amendment are deceptive. The disease when not stationary is progressive, and this explains the fact that few survive the middle period of life.

SYMPTOMS.—The symptoms in cyanosis vary in intensity in different patients, and in the same patient at different times, being milder if he be quiet and the mind calm, more severe if active or if the mind be agitated. In mild cases, in a state of rest, they nearly or quite disappear, so that a stranger would not suspect that there was any serious ailment. They are aggravated by any cause which accelerates the action of the heart. In some patients cyanosis is increased by the most trivial disturbing influences, among which may be mentioned nursing, dentition, crying, coughing, and slight emotions of joy, sorrow, or anger. In more than one case it has been perceptibly increased by the stimulus of digestion, the color being deeper after a full meal than before.

The cyanotic hue varies in different individuals from duskiness to a deep purple, almost black, color. It is usually most marked in the visage, especially the palpebræ, cheeks, nose, and lips, in the ears, fingers, and upon the mucous surfaces. It is sometimes, without any assignable cause, confined to a portion of the body. In a case related by Mr. Steel in the London *Lancet*, 1838, the upper part of the body was livid and œdematous, and the lower part pallid and shrunken, and yet the malformation was of the kind which is commonly present in cyanosis. In the *London Medical Times*, March 8, 1845, copied from the *Gazette médicale*, is the history of a child, six years old, in whom the color was deeper on the right than left side. There had been, however, hemiplegia of this side in infancy, but this had entirely passed off. On the other hand, in a case of rare malformation communicated by Cooper to Farre, in which the upper part of the system was supplied chiefly by arterial and the lower by venous blood, the discoloration was general. In exceptional instances livid maculæ, like those of purpura, have been observed upon the skin.

Those affected with cyanosis have generally at birth been well formed and of the usual size, and in most cases for a considerable period after birth the appetite is good, bowels regular, and the system well nourished. But when cyanosis becomes so severe, as it does sooner or later, that its symptoms are rarely absent, digestion is imperfectly performed and the body becomes either emaciated or stunted and puny. It may be stated, as a rule, that nutrition is in inverse proportion to the gravity of cyanosis. In 33 out of 41 cases in which the condition of the system as regards nutrition was recorded either a short time previously to death or at the autopsy, the body was either considerably emaciated or else diminutive, and those who were well nourished were usually such as had died early or of some intercurrent disease.

In this connection may be mentioned two abnormalities which have been observed in the cyanotic. The chest is often flattened laterally with a projecting sternum, so as to present an appearance generally described in the records as "pigeon-breasted." Sometimes the most prominent part is directly over the heart, and in one or two cases the sternum was observed to be deflected toward the left. In the majority of the records, however, no mention is made of the external appearance of the chest.

The other abnormality is frequently observed in chronic diseases of the heart and lungs, in which there is sluggish circulation and consequent altered nutrition in the fingers and toes. In 28 of the cases collated by myself it is stated that the tips of the fingers or toes, or both, were bulbous. This hypertrophy, if slight, is likely to be overlooked, and that it was observed and recorded in so many cases renders it probable that it was present in a much larger number. In one case the anatomical character of this enlargement was examined, and was found to consist chiefly of hypertrophied connective tissue.

The nails are often incurvated over the deformity. At a meeting of the London Pathological Society in 1859, Mr. Ogle narrated the history of a laborer, fifty years old, who had swelling, numbness, and lividity of the left arm from pressure of an aneurism, and the fingers on this side were clubbed as in cyanosis. A patient whose history is related in the *Glasgow Medical Journal*, and who was believed to be cyanotic in consequence of a highly emphysematous state of the lungs, had a similar development of the tips of both fingers and toes.

An interesting feature in cyanosis is the low grade of animal heat. The temperature of the body is in all cases below that of health. This is especially noticeable in the extremities. There has not been a sufficient number of accurate thermometric observations to determine whether the internal heat is usually reduced. The following only have been recorded: Mr. Fletcher relates the history of a young man in the *Medico-Chir. Trans.*, vol. xxv., in whom the thermometer placed in the mouth did not stand above 80° Fahr. Hodgson reports the case of a man, twenty-five years old, in whom the thermometer placed under the tongue rose to 100°. Perhaps a more thorough examination might have disclosed an intercurrent malady to cause the fever. In an examination recorded by Nasse the instrument placed in the mouth fell little if at all below the healthy standard; applied to external parts, it stood at about 21° Reau. = 79.2° Fahr.

The lack of heat is a source of great discomfort to a cyanotic patient. In mild weather he requires a fire to keep him warm or an amount of clothing which to others would be uncomfortable, and in cold weather slight exposure strikes him with a chill. Nor can he increase his heat by active exercise, since his infirmity disqualifies him for this.

Although the temperature of the surface is so low, the occurence of perspiration, sometimes profuse, is mentioned in several of the records.

In severe cases of cyanosis the generative system is imperfectly developed. In the female menstruation is scanty or delayed, and in the male signs of puberty are feebly manifest. If the disease be so mild that the symptoms are absent when the patient is in a state of repose, these organs attain near or quite their normal development. The catamenia have appeared as as the age of sixteen years, and a cyanotic patient treated by Cherrier had two children, but they both died of scrofulous affections.

The action of the heart is necessarily much involved. In mild forms of the disease, if the patient be quiet, this organ may beat with considerable slowness and regularity, but in all cases exercise or excitement which in a state of health would scarcely have any appreciable effect on the pulse embarrasses its movements and produces palpitation. In severe cases palpitation is rarely absent, and the pulse is frequent, feeble, and often intermittent. In a large proportion of patients bruits are produced by the irregular circulation through the heart.

The respiration corresponds with the action of the heart. It is accelerated in proportion to the frequency of the pulse. The suffering in this disease is largely due to paroxysms of palpitation and dyspnœa. These occur sometimes without any apparent exciting cause and when the patient is quiet, but they are commonly induced by those causes which we have already mentioned as aggravating the symptoms of cyanosis. They come on suddenly, and are attended by increase of lividity, distension of the jugulars, and sometimes of the cutaneous veins, and by a sensation of present suffocation. They last only a few minutes, and are succeeded by great depression of the vital powers. In infants, on account of greater nervous irritability and feeble power of endurance, these paroxysms often end in convulsions, which occasionally are fatal. A cough is sometimes present, but is usually slight.

Pain is not a common symptom. Some of the patients complain occasionally of headache, with or without vertigo, and occasionally also of pain in the chest, but it is uncertain to what extent or whether these symptoms are dependent on the cyanotic disease. The secretions do not appear to be affected, so far as has been ascertained. The same may be said of the intellectual and moral faculties. In a case related by Dr. Cheevers the child was even said to be precocious.[1] The mind is capable of steady application and acquisition, as in health, provided that the emotions are not unduly excited.

The cyanotic are liable to various forms of hemorrhage, but the records show that this liability is greater in youth and adult life than in infancy. In 2 cases blood was vomited, in 1 passed by stool, in 1 it escaped from the gums, in 2 from the mouth, in 8 from the nostrils, and in 16 it was expectorated. Pulmonary phthisis was, however, usually present in these last cases. In the *Western Journal of Medicine* for 1829 an interesting case is related by Dr. William M. Voris of a girl nine years old in whom hemorrhage occurred under the scalp, producing great tumefaction and nearly closing the eyelids. An incision was made, from which a pint and a half of dark blood escaped, and it was estimated that more than half a gallon was lost during the ensuing two weeks, at the expiration of which time the incision closed. The patient recovered from the hemorrhage, but not from the cyanosis.

Toward the close of life more or less anasarca occasionally occurs, especially around the ankles, sometimes in the eyelids and face, and rarely to a certain extent over the whole body. In certain patients it coexists with effusion in the serous cavities.

It is evident that one who is affected with the severer form of cyanosis is disqualified for the duties of active life. The sports of childhood and the useful labors of mature years require an exertion for which he is physically unfit. He has not the ability even to engage in animated conversation, for he is overcome by emotions, whether of joy or sorrow. He lives almost an idle spectator of the world around him, prevented by his infirmity from engaging in its pursuits.

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[1] *Lond. Med. Gaz.*, vol. xxxviii.

Intercurrent diseases, especially those of childhood, are badly tolerated, but whooping cough is the one which these patients are especially ill-fitted to endure. Still, they sometimes pass safely not only through whooping cough, but through some of the most dangerous febrile diseases. It is a question of interest, but about which little is known with certainty, whether these intercurrent maladies are influenced by the cyanotic or venous condition of the blood. The symptoms of these maladies are no doubt more alarming, mainly on account of the embarrassed action of the heart, and not on account of the state of the blood; still, it is reasonable to suppose that malignant and asthenic diseases are rendered worse by the lack of oxygen and excess of carbonic acid in the circulating fluid.

Probably cyanosis does not furnish immunity from any other disease, although this statement has been made by a high authority. Rokitansky says: "All forms of cyanosis, or rather all the diseases of the heart, great vessels, and lungs adapted to produce cyanosis in a greater or less degree, cannot coexist with tuberculosis. Cyanosis affords a complete protection against it, and in this circumstance may be found an explanation of the immunity from tuberculosis which many conditions of the system, apparently very different in their character, afford."[1] This opinion of the distinguished pathologist, notwithstanding his ample opportunities for observation and known accuracy as an observer, is not substantiated by statistics. So far from its being true, the low degree of vitality in cyanosis appears to favor the occurrence of tubercles. I have records of 26 cases of cyanosis in which tuberculosis was also present, in several of which the lungs contained cavities. This is about 13 per cent. of the whole number in my collection—a large proportion, since so many die in early infancy, at which period the tubercular disease seldom occurs. Cyanosis appears also to favor the development of cerebral diseases, especially congestion and coma, as will be seen presently.

PROGNOSIS.—This is unfavorable. Most cyanotic individuals die young. The age which they attain has been made the subject of statistical inquiry by Aberle. He states that in an aggregate of 159 cases, 57, or 35 per cent., died before the end of the first year; 108, or more than two-thirds, died before the age of eleven years; 30 between the ages of eleven and twenty-five years; and of the remaining 21, only 5 lived more than forty-five years.

The age at which death occurred is given in 186 of the cases collected by myself, as follows:

In 17 under the age of 1 week.
" 10 from 1 week to 1 month.
" 12 " 1 month to 3 months.
" 11 " 3 months to 6 "
" 17 " 6 " to 12 "
" 12 " 1 year to 2 years.
" 21 " 2 years to 5 "

In 21 from 5 years to 10 years.
" 41 " 10 " " 20 "
" 20 " 20 " " 40 "
" 4 over 40 "

186, total.

67, then, or more than one-third, died before the close of the first year; 121, or more than three-fifths, before the age of ten years; only 24 survived the age of twenty years, and 4 the age of forty years. Of course the duration of life depends on the nature and extent of the malformations. Some of these are such as render a speedy death inevitable.

MODE OF DEATH.—The mode of death is reported in 95 cases, as follows:

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[1] *Handb. der Path. Anat.*, Bd. ii.

19 died in a paroxysm of dyspnœa.
10 " suddenly (the exact manner not stated).
14 " in convulsions (infants).
2 " of apoplexy.
7 " from hemorrhage.
6 " of phthisis (though, as we have seen, 20 others had this disease).
2 " of exhaustion, without hemorrhage.
10 " of coma.
2 " of abscesses in the brain.

One died of each of the following diseases: cerebral irritation, congestion of brain, effusion in the cranial cavity, acute hydrocephalus, paralysis from acute softening of the brain, dysentery, inflammation of heart, syncope, mucus in the air-passages, thoracic inflammation, choleraic diarrhœa, pneumonitis, bronchitis, scarlet fever, croup; 1 died in trying to walk, 1 after a spasmodic cough in pertussis, 1 after a long agony, 1 after an agony of ten or eleven hours; 1 is reported to have died gradually and 3 quietly.

The 10 who are stated to have died suddenly probably died in paroxysms of palpitation and dyspnœa, which are easily excited and of common occurrence in cyanosis. If so, this was the mode of death in 29 cases. Infants with few exceptions, so far as appears from the records, died in convulsions. 19 died of cerebral affections, exclusive of convulsions, and in 13 of these the cause of death was congestion, apoplexy, or coma. The hemorrhage of which 7 died was probably, in most instances, dependent on phthisis, and 6 are said to have died directly of phthisis. We may, then, regard paroxysms of palpitation and dyspnœa, convulsions, congestive affections of the brain, and phthisis as common modes or causes of death in cyanosis.

The malformations of the heart and great vessels which give rise to cyanosis are quite numerous. The following table exhibits their character and relative frequency:

		Cases.
1.	Pulmonary artery absent, rudimentary, impervious, or partially obstructed	97
2.	Right auriculo-ventricular orifice impervious or contracted	5
3.	Orifice of the pulmonary artery and the right auriculo-ventricular aperture impervious or contracted	6
4.	Right ventricle divided into two cavities by a supernumerary septum	11
5.	One auricle and one ventricle	12
6.	Two auricles and one ventricle	4
7.	A single auriculo-ventricular opening; interauricular and interventricular septa incomplete	1
8.	Mitral orifice closed or contracted	3
9.	Aorta absent, rudimentary, impervious, or partially obstructed	3
10.	Aortic and the left auriculo-ventricular orifice impervious or contracted	1
11.	Aorta and pulmonary artery transposed	14
12.	The cavæ entering the left auricle	1
13.	Pulmonary veins opening into the right auricle or into the cavæ or azygos veins	2
14.	Aorta impervious or contracted above its point of union with the ductus arteriosus; pulmonary artery wholly or in part supplying blood to the descending aorta through the ductus arteriosus	2
	Total	162

From the above table it appears that in more than one half of the cases of cyanosis the congenital vice which gives rise to it is located in the pulmonary artery. It is located also, in general, in that part of the artery which is nearest the heart. Its character is different in different cases. Sometimes there is an arrested development of this vessel, and in its place we find simply a ligamentous cord extending from the heart as far as the ductus arteriosus, while beyond this point the artery and its branches are pervious; rarely the entire artery is ligamentous, and of course impervious; in other cases this vessel is open through its whole extent, but the part nearest the heart is so small as to be properly considered rudimentary; in others still there is adhesion of the valves to each other as the chief congenital defect; and finally, in rare instances the obstruction in the pulmonary artery is due to an adventitious membrane which stretches across the vessel like a diaphragm. These last malformations—namely, adhesion of the valves and the formation of an adventitious membrane—are doubtless due to inflammation occurring in the artery before birth, and some attribute the arrested development and ligamentous state of the vessel to the same cause.

In most cases of cyanosis due to obstructive malformations the interauricular and interventricular septa are more or less deficient. This deficiency obviously results from the obstruction, for the septa are formed in the heart after fœtal circulation is established, and the blood, being prevented by the vicious formation from flowing in its proper channel, necessarily passes to the opposite side of the heart. More or less blood being forced from one auricle or one ventricle to the opposite cavity, it is evident that a permanent aperture must result in the septum. The aperture in the septum ventriculorum is ordinarily at its base; in the septum auriculorum it corresponds with the foramen ovale.

In most of the obstructive malformations one, and rarely two, abnormal cardiac murmurs have been observed. The single murmur accompanies the ventricular systole. As it has been observed in cases of complete as well as incomplete obstruction, it seems to be due mainly to the flow of blood through a narrow or constricted pulmonary artery or the apertures in the septa.

Modes of Compensation.—In most cases of cyanosis the congenital defect is partially obviated by modes of compensation. In the most frequent malformation, that in which there is obstruction in the pulmonary artery and a considerable part if not all the blood flows directly from the right to the left side of the heart, the ductus arteriosus not only remains open, but is greatly enlarged, through which a current of blood enters the pulmonary artery from the aorta, and, passing to the lungs, is oxygenated. The bronchial arteries have also been found greatly enlarged, and it is believed that though they are the nutrient arteries of the lungs, the blood which they convey to these organs is decarbonized in its circuit through them. In a case published by Mr. Le Gros Clark in the *Medico-Chir. Trans.*, vol. xxx., the bronchial arteries were not only enlarged, but a "branch from the internal mammary artery, which accompanied the phrenic nerve, was nearly equal in size to the parent trunk, and expended itself principally in the adjacent adherent lung. Branches of the intercostal arteries have also been found enlarged, and entering the lungs or connecting with vessels which enter the lungs. By such modes of compensation cyanosis is rendered milder and life is prolonged. To these we must attribute the fact that some have very considerable malformation, and yet do not become cyanotic.

Morbid Anatomy.—This, as regards the circulatory system, has been sufficiently dwelt upon. No chemical analysis, so far as I am aware, has yet been made of cyanotic blood. We know that it is dark, its coagulability feeble—that it contains an excess of carbonic acid and is deficient in oxygen. From the nature of cyanosis it would be inferred that in many cases there is a degree of passive congestion in the cavities of the heart, and consequently in the capillaries of the systemic system, giving rise to more or less serous effusion. Statistics show that this is so. The quantity of pericardial fluid is in some patients increased. I have records relating to this fluid in 51 cases. Usually it was pure serum. In 17 the quantity was half an ounce or less, if we include in the number those in which the amount is expressed in such terms as "due quantity," "usual amount," and "small amount." In 24 cases the pericardial fluid (serum) exceeded half an ounce, usually estimated at from 1 to 6 ounces, but in 2 it exceeded the latter quantity. In 1 of the 24 this fluid was stained with blood. In 2 patients the records state that there was a small quantity of pure blood in the pericardium, and in 1 the two pericardial surfaces were agglutinated by inflammation.

In some of the autopsies serum was found in the pleural cavities, usually in connection with pericardial effusion, and in at least one instance this fluid was tinged with blood. Old adhesions between the costal and pulmonary pleura were observed in a few cases. The condition of the lungs was recorded with more or less minuteness in 110 cases. Mention has already been made of the large number affected with tubercular disease, which was either confined to the lungs or was chiefly exhibited in these organs. In 35 patients the records state that the lungs were of small size, either by compression or sometimes, apparently, from the continuance of the fœtal state over a greater or less portion of the organ. The compression was produced either by the distended pericardium or by effusion in the pleural cavities. In 35 cases the lungs presented a dark color. This hue in some specimens accompanied the unexpanded or fœtal state of the organ, but in others there was the normal inflation, and the dark color was due to engorgement or congestion. In other cases the lungs are stated to have been natural except the color. In 9 emphysema was present in a part of the lungs, in 2 pneumonitis; in 2 the color of the lungs was pale, in 1 a bright crimson; in 1 the lungs were larger than natural, in 1 the right lung was absent, and in 17 these organs were recorded healthy.

I have records of the state of the liver in 26 cases, in 16 of which it was enlarged, and in 4 of these it was congested. Congestion of the liver was present in 8 other cases in which no mention is made of its volume. The substance of the liver had a natural appearance in 9 cases, but in some of these this organ was enlarged. From these statistics it is probable that the liver is commonly enlarged in cyanosis, and not infrequently congested. In a few cases the condition of the other abdominal viscera is mentioned—in some as healthy, in others as congested. Fifteen examinations of the brain were made, in 7 of which congestion is recorded, and in 3 abscesses in the cerebral substance, in 1 of which cases the lateral ventricle was also filled with pus; in 2 softening of a portion of the brain had occurred, in 3 the brain was firm or compact, in 3 the quantity of fluid in the cranial cavity exceeded the normal amount, and in 1 it was less than normal.

THEORIES RELATING TO THE ETIOLOGY OF CYANOSIS.—Although in nearly all cyanotic patients there are direct communications between the two sides of the heart, it is shown by many observations that these communications or apertures are not sufficient in themselves to produce cyanosis. This opinion was expressed half a century ago by Louis, who published an excellent monograph on the subject of these communications, basing his remarks on an analysis of twenty cases. Since the publication of this paper, the belief has been pretty general in the profession—and observations continue to substantiate it—that although the apertures may be of considerable size, if the two sides of the heart, with their orifices and vessels, are in their normal state, so that they act symmetrically and without obstruction, the blood is sufficiently oxygenated and decarbonized, and cyanosis does not occur. In proof of the correctness of this opinion many cases might be cited of a pervious and some of a largely dilated foramen ovale without the cyanotic hue—cases which have been published in the journals since the appearance of Louis's monograph. Still, in cases of obstructive malformation, unless the obstruction be complete, cyanosis is more likely to occur in consequence of these apertures, for were they absent a larger amount of blood would be propelled through the narrow orifice of the pulmonary artery, and a larger amount consequently be oxygenated.

Allusion has already been made to the two theories which prevail in the profession: the one attributing the non-oxygenation of the blood and its highly venous character, so as to cause the cyanotic hue, to the intermingling of venous and arterial blood; the other to obstruction at the centre of circulation, and consequent venous congestion. There are serious objections to the acceptance of either theory as an explanation for all cases. That admixture of the two kinds of blood is not essential to the production of cyanosis is apparent from the following facts: In one case in the *Fourth Malformation* there was no communication between the two sides of the heart, and the ductus arteriosus was closed, so that admixture was impossible. Again, in the *Eleventh Malformation*, or that in which the aorta and pulmonary artery are transposed, the blue disease evidently does not depend on the admixture of the two currents. On the other hand, in this curious state of the heart the more the admixture the less the cyanosis, since the only way in which the systemic current of blood can be oxygenated is by passing to the opposite side of the heart. An argument against this doctrine may also be found in the fact that the modes of compensation are not such as in any way to diminish or obviate the admixture. It is admitted that in the more frequent malformations cyanosis is increased by the apertures, which allow the intermingling of the venous and arterial currents, but it is more reasonable to consider the intermingling and the cyanosis as the direct results of the malformation, neither having the precedence of the other, than to consider that they are related to each other as cause and effect or as proximate and remote results. Viewed in this light, the admixture must be considered simply a concomitant of the cyanosis.

The second theory, that of venous congestion, has numbered among its advocates many who have given special attention to the subject, as Morgagni, Louis, and Stillé, but it seems to have even less claim for acceptance than the theory of admixture. It has been seen that in nearly all cases of cyanosis the two sides of the heart communicate freely, so that if the current of blood meets with an obstruction, as it commonly does, it readily escapes to the opposite side, where the artery is large and gives it free passage. In this way congestion, if not prevented, is greatly diminished. Again, it will be seen that, although certain of the viscera are frequently found at the autopsy more or less congested, congestion is not uniformly present in the organs, as it would probably be were it the proximate cause in all cases of cyanosis.

Moreover, in some patients the malformation is not obstructive. The cavities and their orifices are of the normal size, and cyanosis is due entirely to malposition of the vessels. It cannot be said that in these cases there is venous congestion from arrest at the centre of circulation. If there be any congestion, it must be due to the fact that venous blood does not circulate as readily as the arterial in the capillaries. It is true that in the paroxysms of dyspnœa there is sometimes more or less congestion—the distension of the jugulars shows this—but it subsides with the paroxysms, and it probably is no more than usually occurs when respiration is greatly embarrassed.

In fine, attempts to express the immediate pathological state producing cyanosis in the terms of a general law have failed. However plausible the above theories may appear in regard to certain cases, there are others to which they are manifestly inapplicable. Those who advocate these theories see lose sight of the obvious fact that the chief want of the economy in cy is decarbonization of the blood, and it is hardly supposable that there any correct theory of its causation which is not founded on this fact. With this physiological state in view, it does not seem difficult to express a theory in comprehensive terms which is applicable to all cases, such as the following: Cyanosis is due to malformations of the heart and the great vessels in immediate relation with the heart, which prevent the proper flow of blood to and from the lungs, so that the oxygenation and decarbonization of this fluid are inadequate. So comprehensive a statement includes not only cases of malformation and malposition of the heart and its vessels, but also those few cases in which the lungs are in fault. In most patients, as we have seen, the current of blood *toward* the lungs is obstructed, and the current of blood *from* the lungs is obstructed in those comparatively rare cases in which the malformation is on the left side.

TREATMENT.—From the nature of cyanosis it is evident that the treatment should be more hygienic than medicinal. The patient should be warmly clad and kept in a warm room, and all agencies calculated to embarrass or disturb the functions of the body or excite the emotions, and thereby accelerate the heart's action, should be studiously avoided. The diet should be nutritious, but simple and easily digested.

Those who have attributed cyanosis wholly to apertures in the interauricular and interventricular septa, and the consequent flow of blood from the right to the left side of the heart, have considered it an important part of the treatment to keep the patient reclining on the right side, so as to diminish this flow by the effect of gravitation. The reader, however, must be convinced from the nature of the malformations that little benefit can accrue from following such advice. Still, patients are sometimes less cyanotic and more comfortable in one position than another. In a case reported by Mr. Howslip[1] "the only easy and indeed comfortable position in which the child could remain was that usual in nursing. When erect the dusky color of the face and neck became a dark-blue." In a case related by Mr. Spackman[2] the patient was easiest on the hands and knees. Louis reports a case[3] in which the selected position was with the head elevated; Wm. Hunter a case[4] in which the patient avoided paroxysms by lying on the left side. Struthers and King each report a case in which the patients seemed most comfortable while lying on the right side;[5] but, on the other hand, Professor White of Buffalo[6] and Dr. James Carson[7] report cases in which position on the right side failed to produce any alleviation of symptoms. Other similar observations might be cited, but enough have been mentioned to show that no one position should be recommended for cyanotic patients. Some obtain most relief by lying on the back, others on the right side, others on the left; some when on the hands and knees, some when reclining on either side indifferently, while, finally, others suffer least when erect.

There was a time when the paroxysms were treated by venesection, but depletion has long since been abandoned. Physicians now rely on stimulants, antispasmodics, friction to the chest, and mustard pediluvia to relieve the urgent symptoms, although this treatment is but partially successful. It is probable that of all internal remedies digitalis is the most useful, from the fact that it is an efficient heart-tonic and more than any other medicine gives strength and equality to the heart-beats. In the cities where oxygen gas can be procured for daily inhalation the urgent symptoms may in some instances be partially relieved by the use of this agent.

[1] *Edin. Med. Jour.*, 1813.

[2] *Lond. Med. Gaz.*, 1833.

[3] *De la Commun. des Cav.*, *etc.*

[4] *Med. Obs. and Enq.*, vol. vi.

[5] *Monthly Jour. of Med. Sci.*

[6] *Buf. Med. Jour.*, 1855.

[7] *Amer. Jour. of Med. Sci.*, 1857.

CAPUT SUCCEDANEUM.

During the birth of the child extravasation of blood frequently occurs in the part of the scalp which presents. It results from the passive congestion which occurs in presenting parts, and is greatest in amount when the labor has been protracted and the labor-pains unusually severe. *Caput succedaneum* is the term employed to designate the swelling thus produced. Its seat is in the loose connective tissue between the scalp and pericranium, and it consists partly of extravasated blood, but largely of serum which has transuded from the congested vessels before that degree of congestion required to effect the transudation of corpuscles or rupture of capillaries was reached. I have repeatedly had an opportunity to examine this tumor in stillborn infants brought from the lying-in wards of the Nursery and Child's Hospital, and have found when it was slight that it consisted almost entirely of serum, but ordinarily when dissected it presented the appearance of a bruise, with a large proportion of serum, the blood and serum infiltrating the scalp to a greater or less distance beyond the appreciable limits of the tumor. Caput succedaneum requires no treatment. As it lies in the loose connective tissue of the scalp, its liquid permeates the open interspaces in this tissue in every direction, and is rapidly absorbed, while the tumor disappears. Its subsidence is usually complete within twenty-four hours.

CEPHALÆMATOMA.

Occasionally during birth blood is extravasated under the pericranium, detaching it from the bone. This commonly occurs in connection with caput succedaneum, and is observed when the latter declines. Its common seat is upon the occipital or parietal bone, near the posterior fontanel, most frequently upon the parietal, where the pressure during labor is greatest. Prof. Henoch states that the tumor does not obtain its maximum size immediately, but gradually increases by the continued escape of blood until the third day. The tumor may extend over the entire surface of the bone, but it does not pass beyond the suture; the suture limits its lateral extension. Cases of bilateral cephalæmatoma have been reported, but they are rare. The tumor is fluctuating, and the skin covering it has the normal appearance or a bluish tinge, or it may exhibit infiltrations of blood like a bruise. Since the pericranium elevated by the blood does not lose its vitality, it begins to secrete from its under surface preparatory to the formation of bone. In a few days we are able to detect by pressure with the fingers a hard projecting rim at the border of the tumor, the result of the secretion and bony formation at the point where the pericranium is in part detached and in part adherent. If the tumor is tense, we are unable to detect the bone underneath by pressure, and the hard elevated rim resembles the edge of an opening in the skull. The cephalæmatoma when not disturbed apparently causes little or no suffering, but the infant evinces pain if pressure be made upon it. Usually in the second week absorption is so far advanced that the tumor is less tense, and on pressure the bone can be felt underneath it. Complete absorption of the blood which has remained liquid usually occurs in four or five weeks.

Not infrequently, when absorption occurs slowly, a thin layer of bony substance forms in a few weeks on the under surface of the pericranium. This causes a creaking sound when pressure is made [illegible] me since a specimen was presented to the New York Path [illegible] showing a cephalæmatoma and the mode of [illegible] *two months after birth, and the* blood consti [illegible] been in great part absorbed, was completely encased by the old bone below and the new bony formation above. As the blood becomes absorbed the pericranium, having perhaps a bony formation on its under surface, gradually sinks; the cavity at length becomes obliterated; and there only remains some thickening of that part of the cranium which corresponds with the site of the tumor.

A cephalæmatoma might be mistaken by the inexperienced for a congenital meningocele, since the ridge described above which forms along its border resembles so closely the edge of an opening, and both tumors are fluctuating; but a meningocele rarely occurs upon the part of the head occupied by the cephalæmatoma; and if there be any doubt in the diagnosis at first, it will be dispelled in a few days by the changes which it undergoes.

The TREATMENT should be expectant, except that a soft covering of cotton should be placed over it to prevent injury. Experienced physicians who formerly opened these tumors by an incision have abandoned this treatment, and recommend leaving them entirely to nature.

CHAPTER II.

DISEASES OF THE NEW-BORN.

INFLAMMATION OF THE STERNO-CLEIDO-MASTOID MUSCLE.

WE sometimes observe in infants, usually between the ages of one and six weeks, a hard tumor upon the antero-lateral aspect of the neck corresponding to the site of the sterno-cleido-mastoid muscle, and evidently developed in this muscle. It is round or more frequently elongated, varying from the size and shape of a pigeon's egg to that of the little finger, occupying the anterior border of the muscle. Sometimes the tumor, hard like cartilage to the touch, extends over the anterior half of the muscle; and it is stated to occur more frequently in the right than in the left muscle. Prof. Henoch observed it on the right side in 16 cases and on the left side in 5 cases.

The following was a typical case: On July 19, 1887, I attended Mrs. S——, a primipara, in her confinement. Her labor, which was tedious, was terminated by the forceps, without any appreciable injury of mother or child. About one month after her confinement the mother stated that she had observed during the last two weeks an unusual swelling passing obliquely along the side of the neck of the child. I found the anterior portion of the sterno-cleido-mastoid muscle thickened and hard from a point about two lines above its lower attachment nearly its entire length. The swelling was of the size and shape of the little finger of a child of twelve years. It was tender to the touch, never had been red, and the infant's condition was normal in every other respect. At the age of nine weeks the tumor was still appreciable, but had nearly disappeared. Sometimes the tumor is not continuous, but the muscle is thickened and hardened in two or three different places. Occasionally the child's head is turned to one side, either from the pain in holding it erect or because the function of the muscle is impaired.

The etiology and nature of this tumor are apparent from the history. In a majority of the cases the birth of the infants affected with this ailment was edious, and in many the presentation at birth was abnormal. This tumor is especially liable to occur after breech presentations, which necessitate traction upon the neck. In head presentations, when there is delay in liberating the shoulders and traction is made on the head, and especially if forcible rotation is made, the more superficial and exposed fibres in the sterno-cleido-mastoid muscle are liable to rupture; and when this occurs a local myositis results, causing the tenderness, infiltration, and swelling. Certain writers state that more or less extravasation of blood takes place at the time of the accident, and before the inflammation supervenes, and hence the term "hæmatoma" which has been employed to designate the disease. But I have seen no evidence of hemorrhage—none of the bluish discoloration which indicates extravasation so common in bruises—in any of the cases which I have observed.

The PROGNOSIS is good. Suppuration does not occur unless under very unusual circumstances, and, though probably more or less cicatricial tissue results at the seat of injury, the function of the muscle is not appreciably impaired when the inflammation and swelling abate. No perceptible contraction or deformity results. But little treatment is required; indeed, patients do well without treatment. But it is best for the infant that it maintain so far as possible a horizontal position, with the head resting on a pillow and with the avoidance of rotation so long as the disease is in its active stage and the tumor is tender to the touch. Probably cool lotions recommended by some are as likely to do harm as benefit by giving cold to the child and producing nasal or other catarrhs. Inunction with an ointment of iodide of potassium has been recommended for the purpose of promoting absorption, as the following:

℞. Iodidi potass.,	
Aquæ,	*āā.* 1 part;
Adipis,	2 parts;
Lanolin,	6–8 parts.

But without this treatment absorption is progressive and cure complete within a few weeks.

MAMMARY GLANDS.

In newly-born infants the secretion of a milk-like substance begins at about the fourth day in the mammary glands. It increases until the tenth day, when it gradually diminishes, and disappears at about the twentieth day. It is attended with some swelling of the glands during the period of their activity, and after the secretion ceases the enlargement gradually abates. M. Guillot states that this secretion presents under the microscope the appearance of colostrum.[1] A section of the gland in which this secretion has occurred, made near the surface, shows epithelium. At a greater depth the canals enlarge, divide, and end in cavities which are filled with a liquid having the appearance and character of colostrum. This glandular activity, it is said, may begin before birth, and continue six or eight weeks after birth, but the period of greatest enlargement and most active secretion of the gland is usually between the fourth and tenth days after birth, as stated above.

MASTITIS.

In exceptional instances the enlargement of the gland and its functional activity result more seriously. The gl [illegible] med, and an abscess may occur as in the adult female. [illegible] e this result by rubbing and pressing the gland, so that rude manipulation of it should be avoided. An abscess destroys the gland-structure, which is a serious result if the infant be a female. M. Bouchut, in his practical treatise on diseases of the newly-born (p. 719, 1867), relates a fatal case of mastitis in which the inflammation extended to the connective tissue, and ulceration so extensive occurred that the pectoral muscle was exposed, and death resulted from prostration. Dr. A. Jacobi has observed similar cases.[1] Therefore in treating the enlarged and secreting gland of early infancy very gentle and unirritating measures should be employed, so that mastitis may, if possible, be prevented. The dress should be loose, so as to avoid pressure on the gland. If no inflammation, or inflammation in its commencement, be present, absorbent cotton or cotton soaked with sweet oil should be applied and covered with oil silk. It is proper also to apply a mild lead wash to the enlarged mammary gland, especially if it be hot. If it be indolent, iodide of potassium in glycerin, one part of the former to ten of the latter, may be used. If the gland be hot, and especially if it be red, a soft emollient poultice should be applied, as of bread and milk or flaxseed and water. If, unfortunately, suppuration occur, an early incision should be made as far as possible from the nipple. In the subsequent treatment mild antiseptic washes, as boric acid or listerine and water, should be used. Corrosive sublimate should not be employed, as young infants are readily poisoned by it, and, for the same reason, carbolic acid should not be used or be used in a very weak solution. Iodoform should also not be used, or used largely diluted by the addition of starch.

CONJUNCTIVITIS.

(Ophthalmia Neonatorum; Purulent Conjunctivitis of the Newly-born.)—Different forms of conjunctival inflammation occur in the newly-born. In the mildest variety no appreciable swelling of the lids occurs, and only a little viscid secretion collects between the lids, which agglutinates them in sleep, and which the nurse readily removes by bathing them with tepid water or milk and water, and in a few days effects a cure. On the other hand, the purulent form of conjunctivitis, which is observed on the second or third day after birth, and which arises from the reception between the lids of the vaginal secretion of the mother, always involves great danger to the eye, speedily producing opacity or destruction of the cornea, unless promptly and properly treated Between these two extremes conjunctivitis neonatorum occurs in different grades of severity.

Mild or Catarrhal Conjunctivitis.—This, as the name indicates, is a simple catarrh, attended, as stated above, by a slight viscid secretion from the lids and by little or no swelling. The secretion collects in the angles of the lids and along their margin. This mild conjunctivitis requires very simple treatment. Warm water or milk and water should be gently applied by a large camel's-hair pencil, so as to wash away the secretion as soon as it forms, and sweet oil or vaseline should then be applied between the lids. With these simple measures this mild conjunctivitis disappears in a few days.

If the secretion be more abundant and the lids perceptibly swollen, more active measures are required. Prof. Noyes states that there is a variety of catarrhal ophthalmia neonatorum which requires active treatment. In the cases alluded to the ocular surface is but slightly involved, having little or no hyperæmia, but the palpebral conjunctiva is hyperæmic and the fornix thickened and swollen. The swelling of the fornix is the most marked anatomical character. The secretion has a watery appearance, and the lids are but slightly tumefied. The cornea does not become hazy and the sight is not impaired, but the watery discharge and the viscid secretion on the borders of the lids continue for weeks, unless the case be promptly attended to. Prof. Noyes recommends for this form of catarrhal ophthalmia neonatorum the application several times daily of the boric-acid solution:

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[1] *Archives of Pediatrics*, March, 1888.

℞. Acidi borici,	gr. xv;
Aquæ,	℥j. M.

He adds: "But if a child is a month old and the discharge continue, and the fornix exhibit decided swelling, I have been obliged to use solutions of tannin and glycerin as strong as ℈ij, ad ℥j, before the condition would yield. I had tried nitrate of silver in mild solution, and, unwilling to make it more caustic, had taken a solution of tannin gr. x, ad glycerinum ℥j, but this had only a temporary good effect, and the disease was not subdued until the strong solution was applied. It was done every second day to the everted lid, and was of course quite painful."

Purulent Ophthalmia Neonatorum; Gonorrhœal Ophthalmia Neonatorum.—This is one of the most important diseases to which the neonati are liable, since, if not promptly and properly treated, it is very damaging to the eye, permanently impairing or totally destroying vision. It is produced by the lodgment in the eye of irritating matter, usually the gonorrhœal vaginal secretion of the mother. A minute amount of the virulent matter is sufficient to set up the inflammation. Recent observations seem to show that in a considerable number of cases the poisonous matter is received, not during birth, but in the washing, or subsequently from the fingers of the nurse or mother, or through the medium of soiled towels or linen. Dr. Joseph A. Andrews, in an interesting paper on contagious eye disease published in the *New York Medical Journal*, 1886, quotes the following table from Theremin, showing the time of commencement in 476 cases, as follows:

First to fourth day after birth	57	cases.
Fourth to eighth day after birth	134	"
Eighth to fourteenth day after birth	94	"
Later	104	"

When the disease begins subsequently to the first week after birth, it is evident that the infection occurs post-natum, the poison being conveyed to the eyes through the soiled fingers or sponges or cloths employed in the nursery, as stated above.

The infectious principle contained in the gonorrhœal discharge of the mother is now admitted to be a micro-organism, designated the gonococcus, discovered and described by Hallier in 1869 and Salisbury in 1873. The attention of the profession was especially drawn to it by Herr Neisser of Breslau in 1879, whose description of it was more full and accurate than that of his predecessors. Recently it has been carefully examined with the aid of coloring tests by C. W. Allen and E. C. Wendt of New York City, and their monograph relating to it is one of the best yet published. The gonococcus is a "comparatively large" microscopic organism, round at first, but becoming elongated or oval, and then dividing by fission so as to become a diplococcus. Subsequently division in the [illegible] tion occurs, and this process continues until the pus-cell i[illegible] is filled with these organisms. It is within t[illegible] d not on their exterior, that the segmentation and development of the gonococcus take place; but diplococci may be observed in the intercellular fluid, probably having escaped from the pus-cells.

In acute gonorrhœa usually no other or but few other bacteria except the gonococcus are observed; but in chronic gonorrhœa of both sexes other microbes are commonly present in addition to the gonococcus. That the contagious and virulent property of gonorrhœal pus is due to the gonococcus seems to be fully established, but were the action of this organism limited to cases of gonorrhœa it would be less important as a pathological factor. Microscopic examinations show its presence in the pus of ophthalmia neonatorum, as well as in the vulvitis of childhood, when of gonorrhœal origin, and the intense inflammation and rapid destruction of sight in the former disease are believed to be due entirely to its agency.

Dr. Gayet, professor of ophthalmic surgery, Lyons, France, says that the detection of the gonococcus in infected pus is as simple and easy as that of albumen in albuminuria. He places a particle of pus on a glass slide, covers it by another slide, and presses the two together. They are then separated, and stained by dropping on them an alcoholic solution of methyl-blue mixed with an equal quantity of water. After two minutes the slides are washed freely with water, and each leucocyte is seen to have two, three, or four nuclei, "this being a special character of the disease, the increase in the number of nuclei heralding the approach of the gonococci, which will be observed as intensely blue spherical bodies in the interior of some of the leucocytes."[1] If the gonococcus be found in a single leucocyte, of course the diagnosis is established.

SYMPTOMS.—Stellwag says: "The period of incubation after successful inoculation of the contagious material varies between some hours and days. The outbreak of the blennorrhœa follows the more quickly the more favorable are the conditions for the inoculation—*i. e.* the more powerfully the secretion was able to act." In most instances when infection occurs during birth some evidence of the disease appears as early as the second or third day. The inflammation is from the first severe. The conjunctiva, ocular and palpebral, is intensely hyperæmic; chemosis soon occurs in most instances, and an abundant muco-purulent or purulent secretion flows between the lids mixed with tears. The inflammatory hyperæmia not only extends over the entire conjunctiva, but also to the connective tissue and the integument of the lids, causing in the latter a dusky or bluish-red tint. At a later stage the tint may be yellowish-red. The eyelids swell rapidly in consequence of the looseness of their connective tissue and the great amount of infiltration, so that they appear as projecting tumors pressing against each other and upon the eye, concealing the latter from view. The ocular conjunctiva, from the great amount of serous exudation underneath, rises up like a circular wall around the cornea, which appears sunken in the centre of the swelling, and sometimes only its central part is visible in consequence of the bulging of the swollen conjunctiva over it. The palpebral conjunctiva is so swollen from the serous infiltration that it bulges forward on attempting to separate the lids, and eversion of them is liable to occur. From the great amount of tumefaction of the lids the palpebral fissure is closed, and the upper lid may project over the lower so as to nearly cover it.

The danger to the eye results chiefly from the chemosis, or hard and tense œdema, of the subconjunctival areolar tissue, which by its pressure may obstruct circulation. The eye is photophobic, tender to the touch, and the seat of severe pain. The intensity of the inflammation gives rise to active fever. The inflammation, having reached its maximum, soon begins to abate under correct treatment; the bright-red erysipelatous hue of the lids changes to a bluish color; the heat and tenderness abate. The secretion is abundant, and is constantly escaping from the conjunctival sac and flowing over the cheek, which is often reddened in consequence of its extreme acridity. If in the height of the inflammation we attempt to separate the lids, which are firmly pressed together not only in consequence of the great amount of tumefaction, but also from the spasmodic contraction of the orbicularis palpebrarum, the purulent secretion gushes forth, consisting of greenish or grayish pus—a thick liquid containing flocculi of epithelial cells and muco-pus. Occasionally, when the inflammation is intense, these flocculi contain also fibrin. The discharge, consisting chiefly of muco-pus mixed with tears, has a creamy appearance, but if the lachrymation be abundant it may resemble whey in color and consistence, especially in the declining stage.

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[1] *La Province médicale*; Lond. Lanc., June 18, 1887.

Course; Results.—Purulent conjunctivitis of the new-born usually begins in one eye, and unless the sound eye be immediately and efficiently protected, the inflammation ordinarily soon attacks this eye. Of course both eyes may be simultaneously affected, but in a large proportion of patients there is an interval of a day or two in the commencement of the inflammation in the two eyes, that secondarily infected receiving the virus from the one first attacked.

In the milder cases the inflammatory symptoms, the hyperæmia, tumefaction, heat, and secretion increase gradually, and it is not until the fifth or sixth day that they attain their maximum. In severe cases the symptoms reach their height by the close of the second or third day. The inflammation, having attained its maximum, as indicated by the heat, swelling, and abundant secretion which wells up between the lids, soon begins to abate under correct treatment. But several weeks elapse before the normal state is restored, a simple catarrhal inflammation continuing after the purulent and infective secretion has ceased.

The danger to the eye depends upon the severity of the inflammation. If the chemosis be not great, and the swelling be more œdematous than indurated, and the amount of secretion moderate, the eye is usually saved by timely and correct treatment. In severe inflammation characterized by great chemosis, hyperæmia, and heat and an abundant purulent discharge, the peril to the eye is imminent, since the inflammation is likely to extend from the conjunctiva to the cornea, and ulceration result. When the cornea becomes cloudy in places the danger to the eye is extreme, but the sight may be preserved, though abscesses and ulcers occur, provided that they are small and involve only a part of the cornea. Abscesses and ulcers near the margin of the cornea are less dangerous than those in the centre, but crescentic peripheral ulcers are of bad import, since they are likely to increase. If marginal softening and a central abscess or ulcer coexist, the sight will probably be lost. Of course the more quickly the inflammation is subdued the better the prognosis.

Preventive Measures.—Since purulent conjunctivitis of the new-born is so rapid in its progress and so destructive to the eye, it is very important that its occurrence should so far as possible be prevented, and, fortunately, it is a preventible disease. The employment of efficient preventive measures is one of the recent achievements in midwifery practice. Statistics abundantly show the need and efficiency of such measures. At the meeting of the Blind Congress, held in Paris in 1879, F. Dumas stated that of 1178 blind patients whom he had treated, 1070 became blind from curable [illegible] f this number, 817, or 69 per cent., lost their sight from [illegible]

According to Horner, of the blind children [illegible] *Germany and Austria, from 20 to 79 per* cent. [illegible] ease.[1] This was before the efficient prophylactic measures now in use were employed.

Inasmuch as this malady is produced by the infective vaginal secretion of the mother coming in contact with the eye of the infant at birth, the use by the mother of antiseptic and disinfectant vaginal douches before and during parturition is suggested as the appropriate preventive treatment in case she have a muco-purulent discharge. For this purpose carbolized vaginal injections have been employed, with the result of diminishing the number of cases of ophthalmia neonatorum. Mules[2] advises the following very judicious and important preventive measures: "1st. Cure all cases of chronic vaginal discharge before labor. 2d. Irrigation of the vagina during the second stage of labor when vaginitis is known to exist. The solution used for this purpose in Queen Charlotte's Hospital is corrosive sublimate (1:2000). The copious secretion of a clear vaginal fluid before and during labor, and the flow of the liquor amnii just before the birth, diminish the danger. 3d. Assist the fœtal eyes to pass beyond the perineal edge without resting. This is easily done by hooking around the perineal edge with the fingers and drawing it down. 4th. By wiping the eyes with a clean cloth at birth of head. 5th. By instilling an antiseptic solution into the eyes at birth if the mother has a discharge. 6th. Credé's method: to wash the face first, never in water in which the body has been washed. 7th. To retain one sponge or flannel especially for the child's face, and insist on scrupulous cleanliness. 8th. The nurse to wash her hands after adjusting the mother before touching the child. 9th. Not to expose child unduly to draughts, bright light, etc. 10th. To protect the child from flies with a thin veil. 11th. To remove carefully the child from the presence of another similarly affected; strict isolation of an infected case. 12th. To guard the one eye if the other is affected." The 10th and 11th rules are evidently applicable to cases in maternity wards, rather than to those in private practice.

But in order to gain the highest degree of success by preventive measures, it has been found necessary to treat the eyes of the infant immediately after birth if there be the least reason to suspect the presence of an infective vaginal discharge in the mother, so as to destroy the poison if it have lodged in them. In the lying-in asylums, where, in consequence of the prevalence of gonorrhœa in the mothers, ophthalmia neonatorum of a severe form has been prevalent, antiseptic treatment of the eyes of all the newly-born has either entirely prevented this disease or rendered it of rare occurrence. To Credé of Leipzig more than to any other physician the credit belongs of having established this treatment. Its efficacy is now universally recognized.

Bathing the eyes of infants immediately after birth was previously practised by Abegg, who employed only water, and by Olshausen, who, through Von Graefe's advice, employed a 1 per cent. solution of carbolic acid. Although this treatment diminished the number of cases of ophthalmia, it was far surpassed in efficiency by that recommended by Credé, who in 1880 began to treat the eyes of the newly-born in the following manner: The external surface of the lids was first washed with plain water; the lids were then separated, and a single drop of a 2 per cent. solution of nitrate of silver was allowed to fall upon the cornea from the end of a glass rod. From 1880 to April 1, 1883, Credé treated 1160 infants in this way, and only 4 became affected with ophthalmia neonatorum. This treatment by nitrate of silver, employed in other institutions in Europe and in this country, has been followed by signal success. Thus, Dr. Garrigues of New York employed Credé's treatment in the Maternity Hospital on Blackwell's Island, where ophthalmia neonatorum had previously been of common occurrence, and of

[1] *Archiv für Gynäkologie*, 1883.

[2] Prize Essay, Manchester Chronicle, Jan., 1888.

351 infants born consecutively "not a single one was affected."[1] Dr. Garrigues adds that in these cases occasionally a thin discharge like serum followed the application of nitrate of silver, due apparently to its irritating action, and that the first cases in which he observed this discharge he treated with iced compresses and the instillation of a saturated solution of boric acid. But afterward he found that they quickly recovered without such measures. Occasionally so many drops of the nitrate were inserted by accident that a black ring was produced upon the eyelids, without any ill effect to the eye. Dr. Garrigues recommends Credé's method of employing a glass rod, to which a single drop of the solution adheres, so that there is no risk that more than this amount will be instilled. The application should be made as soon as the infant is removed from the bed to the lap of the nurse. She should first clean the eyelids and the face, and in washing them should be careful that none of the wash enters the eyes. A weaker solution of nitrate of silver has been employed without the good results which follow the use of the 2 per cent. solution. Credé made tentative use of borate of sodium (1 : 60), and found it greatly inferior as a preventive to the nitrate of silver.[2]

Of course preventive treatment of this kind should not be recommended in general midwifery practice, except when there is evidence or strong suspicion that the mother has gonorrhœa. Moreover, much can be done toward diminishing the number of cases of blindness resulting from ophthalmia neonatorum by disseminating among the masses a knowledge of the imminent danger to the sight of the newly-born infant when a purulent discharge occurs from its eyes, so that instead of employing domestic remedies the parents will seek at once the advice of the accoucheur or family physician.

TREATMENT.—No disease of early life so imperatively requires early, persistent, and correct treatment as the purulent form of ophthalmia neonatorum. If proper measures be employed sufficiently early and persistently, the eye can nearly always be saved. Since this malady has a microbic origin, it is evident that an efficient germicide is required in the treatment—an agent that does not injure the eye, while it destroys the cause of the inflammation. Various germicides have been employed for this purpose, but the two which have been found safest, and at the same time most efficient, are corrosive sublimate and nitrate of silver.

The late Prof. S. D. Gross long before the microbic causation of the infectious diseases was known, and before antiseptic treatment had come into use, had in his large clinical experience discovered the efficacy of the corrosive-sublimate treatment. In his *System of Surgery*, published in 1859, he wrote: "In the purulent ophthalmia of infancy I have usually effected excellent and even rapid cures by the injection every few hours of tepid water or milk and water, followed immediately after by a solution of bichloride of mercury, from the eighth to the twelfth of a grain to the ounce of water;" and again he wrote: "The bichloride of mercury is, of all the local remedies that I have ever tried in this affection, the most efficacious in its action, making generally a most rapid and decided impression upon the discharge." Oppenheimer of Heidelberg in his experiments on the gonococcus, which he cultivated in blood-serum, found that corrosive sublimate, 1 : 40,000, retarded its development, and 1 : 20,000 destroyed its vitality.[3] Nitrate of silver was also used in the treatment of purulent ophthalmia neonatorum long before the gonococcus was discovered, and before the need and efficacy of germicide remedies in the treatment of the infectious diseases were known or recognized. Von Graefe more than thirty years ago everted the lids when it was possible, applied the mitigated stick of nitrate of silver to the mucous surface, washed it with salt, and replaced the lids. This treatment is still employed by some specialists in ophthalmic practice. Dr. Gayet[1] everts the lids so as to stretch the mucous membrane, when he thoroughly washes the folds of the conjunctival sac by means of a ball syringe. The lids are replaced, rubbed so as to displace pus-cells and force them into the conjunctival sac, again everted and syringed. The mitigated stick is then applied to the palpebral mucous membrane, and the nitrate of silver immediately neutralized and washed away by a solution of chloride of sodium. The lids are then replaced. In the subsequent treatment the mother or nurse washes the eye with a solution of corrosive sublimate (1 : 6000), and frequently renews upon the lids compresses wet with ice-water. But most of the leading oculists employ nitrate of silver in solution in the manner presently to be described.

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[1] *Amer. Jour. of Med. Sci.*, Oct. 1884.

[2] *Arch. f. Gynäk.*, xxi. p. 193.

[3] Andrews: *N. Y. Med. Jour.*, Sept. 25, 1886.

We again call attention to the necessity in this disease, more than in almost any other, of employing faithful and attentive nurses, who will carry out punctually the directions given. Two nurses are required—one to serve by day and the other by night—since it is essential that the eye be frequently cleaned and the secretion washed away.

If the conjunctivitis be purulent, but mild, and attended by a slight discharge and little or no appreciable swelling of the conjunctiva, two drops of a 2 per cent. solution of nitrate of silver should be instilled once between the lids, and the lids moved to ensure its flowing underneath them:

℞. Argent. nitrat., gr. vj;
Aq. destillat., ℥v. M.

In the subsequent treatment a strong solution of boric acid—some recommend a saturated solution—should be instilled every half hour, the lids being drawn widely apart. The frequent wide separation of the lids, which can be accomplished without undue pressure upon the eye, is useful in allowing the pus to escape, as well as in facilitating the application of the wash. I prefer, however, unless the disease yields quickly, the use of a weak solution of corrosive sublimate in place of the boric acid, employing the following formula:

℞. Hydrarg. chlor. corros., gr. j–ij;
Aquæ destillat., Oj. M.

The use of this mild solution of the sublimate every second hour after a single employment of the nitrate of silver usually suffices to cure mild cases in a few days.

If the disease be more severe, but still mild, and accompanied by moderate tumefaction and a moderately increased secretion, a single daily application of the nitrate of silver suffices during the active period of the inflammation. In severe forms of the disease, accompanied by much tumefaction and the frequent gushing out between the lids of a thick, purulent secretion, the nitrate-of-silver solution should be used as often as every six hours. Dr. David Webster of the Manhattan Eye and Ear Hospital states that he has employed the nitrate of silver in these severe cases five times in twenty-four hours with great benefit. As regards the frequency of the application of nitrate of silver, and the time when to desist from its use, Andrews writes: "The only guide which I know is the condition of the conjunctiva. When there is slight hyperæmia only, the slough produced by the nitrate of silver requires a long time to be cast off," and it is very irritating. But if there be a more severe inflammation, with much swelling, the slough is thrown off in a few hours. The use, therefore, of nitrate of silver at intervals of a few hours should be practised only in the most severe forms of the inflammation, while in the milder cases it should be used only once or at long intervals. In the declining period of the disease the application of a solution of boric acid or a weak solution of corrosive sublimate, gr. 1 to the pint of distilled water, suffices to effect a cure.

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[1] *La Province médicale; London Lancet*, June 18, 1887.

UMBILICAL VEGETATIONS.

Not infrequently small excrescences sprout out from the base of the umbilical depression at the time or soon after the fall of the cord. They have the appearance of those vegetations which arise from open sores, and which have been designated, in common parlance, proud flesh. One of the first, if not the first, monograph on these outgrowths appeared in the *Medical Dictionary* in 1834 from the pen of M. Dugès. They have been designated in different languages by many appellations, as fungous excrescence of the umbilicus (Condie), excrescence of the umbilicus (Cooper Foster), warty tumor of the umbilicus (Holmes), bourgonnement de l'ombilic (Depaul), granulome de l'ombilic (Dechamber), végetation ombilicale (Guersant). Virchow has also alluded to them in his treatise on tumors, and a carefully-prepared and instructive monograph relating to them appeared in the *Rev. Mens. des Malad. de l'Enfance*, Juillet, 1886, from the pen of M. Broussole.

The size attained by these growths is always small. Many of them are not larger than a pea in their greatest development. Their form appears to be determined in a measure by the external pressure. Some are rounded, and others are elongated or cylindrical. French physicians have likened them, as regards appearance, to a small strawberry or a small cherry, and sometimes, when small and elongated, they have been likened in shape to a grain of wheat or barley. Guersant and Owen have described them as having a nipple- or polypus-shape, according to variations in their base. It is only in exceptional instances that they have so red a tint as a strawberry or cherry. Their color varies from a pale red to a red of a deeper tinge, according to the degree of vascularity, and they are always moist.

This outgrowth is distinguished by its irreducibility and its consistence. Digital pressure may cause it to disappear in the umbilical fossa: it disappears by depressing the floor of the fossa. It reappears in its entirety by the resiliency of the walls of the fossa as soon as the pressure is removed. It has the soft consistence of fungous tissue, so that it is depressed and flattened and its shape changed even by slight pressure. It arises in most instances from the inferior part or floor of the umbilical fossa, and it contrasts in appearance with the cutaneous folds of the umbilicus by its softness and reddish tinge.

This tumor does not exhibit any tendency to ulceration or to hemorrhage in the proper sense of the term, but a sanguinolent serum exudes from it and stains the linen unless the growth be small. The thin irritating discharge from the surface or base of the vegetation sometimes causes small excoriations upon the edge of the fossa. In a child of one year and a half, whose case is detailed by Foster, the ulceration from this cause attained considerable size. It is said that cases have been observed in which the redness increased when the infant cried, and other cases in which the vascularity was such that more or less hemorrhage occurred when the tumor injured. In these last cases umbilical nævi may have been mistaken *vegetations.*

PROGRESS.—This vegetation in the first days or weeks increases more rapidly than subsequently. It may attain half the size or the full size of a pea, or even a greater development, by successive sprouting of granulations. It may increase slowly during many weeks or months, or it may come to a standstill and show no tendency to diminish or atrophy. In time, according to several writers, it is likely to shrivel and skin grow over it, and thus be cured. But more frequently surgical interference is required.

ETIOLOGY.—It is reasonable to suppose that some excoriation of the surface precedes the granulations, and affords the base on which they arise; but why one child has this outgrowth, while another child, with the same management of the cord and apparently the same condition of the umbilicus, is free from it, does not perhaps admit of explanation.

DIAGNOSIS.—This is readily made. The small size, irreducibility, reddish hue, the serous oozing which stains the linen yellow, the softness, like exuberant granulations in other localities, and the shape, enable the physician to diagnosticate this growth from any other kind of acquired tumor. An umbilical nævus has greater firmness and a deeper red color, which disappears on pressure and becomes more pronounced when the infant cries. The nævus is also less elevated, and it extends laterally and vertically farther than the vegetation, often passing beyond the umbilicus. From other tumors occurring at the umbilicus, as adenoma and sebaceous and other cysts, the diagnosis is easily made. since tumors other than the vegetations and nævus are covered with skin, are not attended by the serous oozing which stains linen, and most of them are congenital.

HISTOLOGY.—M. Albarran and others have made microscopic examination of these vegetations, and found that they consisted of frail, feebly-organized connective tissue, round cells with large nuclei, capillaries with walls consisting of swollen endothelial cells, and vessels of larger size with narrow lumina and with walls formed by concentric layers of flattened fusiform cells. In another case examined microscopically fasciculi crossed each other, forming alveoli which contained cellular elements that were abundant in proportion to the fibrillar stroma. The vegetations always contain numerous small blood-vessels, true embryonic capillaries, with walls consisting of young cells arranged concentrically. They are made up of these small vessels, frail connective-tissue cells, and some granular intercellular substance.

TREATMENT.—Cauterization by nitrate of silver acts slowly, but sometimes destroys the vegetation if small. More efficacious and preferable treatment is to remove the growth by the scissors or ligature. Saint-Germain operates as follows: The fold of the skin surrounding the umbilicus is depressed, while slight traction is made on the excrescence by the forceps. The pedicle is then strongly tied by a silk thread previously dipped in a solution of carbolic acid. Slight traction then suffices to remove the growths, and they sometimes drop off in the tying. After the removal a little iodoform should be dusted into the umbilical fossa, and the umbilicus covered by a pledget of surgeon's lint retained in place by strips of adhesive plaster.

UMBILICAL HEMORRHAGE.

Hemorrhage occurring at birth or soon after from too loose ligation of the cord, or from its laceration, is so well known and its cause so apparent that it need only be alluded to in this connection. Bouchut relates a case in which death took place from this cause even before birth. The child was attached to the placenta by a navel-string so short that it prevented delivery till it parted by the traction of the forceps. The bleeding from the umbilical vessels was so profuse that the child was pallid and lifeless when born.

But another form of umbilical hemorrhage sometimes occurs in the newly-born. The oozing takes place from the umbilicus itself, and not from the loosely-tied or torn umbilical cord. One of the first cases on record of this hemorrhage was published in the *Gentleman's Gazette*, in April, 1752, by Mr. Watts of Kent, England; but after the publication of this case a century elapsed before umbilical hemorrhage attracted the attention which it merited. In April, 1852, Dr. Francis Minot read a paper on this disease, containing the statistics of 46 cases, before the Boston Society for Medical Improvement. Three years subsequently, in 1855, Dr. Stephen Smith of New York read a monograph on the same subject, containing the statistics of 79 cases, before the New York Statistical Society. This was followed in 1858 by a statistical paper from the pen of Dr. J. Foster Jenkins, read before the United States Medical Association and published in its *Transactions* for that year. This monograh was elaborate, since the writer succeeded in obtaining the histories of 178 cases from medical journals and members of the Association.

SEX; AGE.—In the cases collated by Jenkins, 34¼ per cent. were females and 65¾ per cent. males. However, it seems improbable that sex produces any difference in the liability to umbilical hemorrhage. The following table gives the ages at which the hemorrhage began in 99 cases:

Age.	No.	Age.	No.
On the 1st day	5	8th to 10th day, inclusive	25
" " 2d "	7	11th to 15th " "	16
" " 3d "	6	16th to 21st " "	4
" " 4th "	3	22d to 56th " "	1
5th to 7th day, inclusive	32		99

These statistics are interesting as showing the relation of the hemorrhage to the umbilical cord. In the 18 cases in which the hemorrhage occurred under the age of three days it may be assumed that the cord was attached, and the blood escaped from the walls of the umbilical fossa outside of the line of its attachment. Immediately after the fifth day, or after the time when the cord falls, there was a large increase in the number of cases, so that from the fifth to the fifteenth day after birth was the period of greatest liability to the hemorrhage. Since, as many observations have shown, in a large proportion of cases the blood has feeble coagulability, it seems probable that the umbilical vein and the umbilical and hypogastric arteries may not have been occluded by fibrinous coagula in at least some of these patients, as they commonly are in the healthy, and that the hemorrhage occurred in part from these vessels. This hypothesis is rendered more plausible by the fact that from the general ill-health present in many of these infants, probably the walls of the vein and arteries were lacking in contractility, so that they remained more patulous than in robust and healthy infants.

CAUSES.—Hemorrhage from the umbilicus, as well as from other parts in the newly-born, must be referred to a faulty composition of the blood, especially its feeble coagulability, or to an abnormal state of the walls of the minute vessels, or to both these causes. The hemorrhage is sometimes referable to the hemorrhagic diathesis or hæmophilia, which may be inherited or may result from obscure causes in children born of healthy parents. In the New York Infant Asylum a well-developed and apparently healthy mulatto woman gave birth to her first infant on November 30, 1886. She stated that her family were healthy and that the father of the child was also in excellent health. The birth was easy and natural, and nothing unusual was observed in the infant, which weighed nearly ten pounds, except a swelling from extravasated blood above and in front of the right ear. At 7 A. M.

on the next day severe umbilical hemorrhage occurred, which was checked by styptics; then slight epistaxis took place. At 11 A. M. bleeding from the navel returned, and appeared to come from several points at the margin of separation of the floor of the umbilicus from the cord. The tumor above the ear increased, purpuric spots appeared upon the integument, and death occurred from exhaustion on December 2d. The infant lost one pound in weight during the two days of its existence. At the autopsy a few small superficial erosions could be made out in the umbilical fossa at the point of union with the cord. The umbilical vein, traced to the liver, and the hypogastric arteries, traced to the iliac arteries, contained no blood, were patulous, and apparently normal. Extravasations of blood were found under the skin, in the abdominal cavity, and at numerous points in the lungs, etc. The organs had an exsanguine appearance, and everywhere the blood was without clots, its fluidity being a notable peculiarity The cause of the hæmophilia in this child was not apparent. Its parents, so far as could be ascertained, were healthy; still, it may have belonged to a family of bleeders, for the hemorrhagic diathesis sometimes passes over one generation and reappears in the next.

Syphilis is one of the recognized causes of the hemorrhagic diathesis in the newly-born. In 1871, I was requested to visit a neonatus that was a bleeder, whose father was unmistakably syphilitic, and whose mother was suspected to have contracted syphilis from her husband. The child was fairly developed, and the cord separated on the sixth day. A constant oozing of blood from the navel commenced on the seventh day, on account of which I was summoned to the case. I finally succeeded in arresting the bleeding by the application of the plaster-of-Paris dressing, but immediately intestinal hemorrhage commenced, of which the child died in twenty-four hours. The parents were induced to take antisyphilitic remedies for a considerable time, and they have since had four healthy children. In another instance observed by me, an infant, puny and apparently premature, was at birth observed to have several blebs of pemphigus, from which blood soon began to ooze, but the umbilical hemorrhage from which the child died did not begin until about the fourteenth day.

Two elements or factors appear to be present in producing hemorrhagic syphilis in the newly-born. We have already alluded to abnormal fluidity of the blood, for when it escapes it does not coagulate or its coagulation is very inadequate. The other factor is abnormalities in the minute vessels. Many years ago the eminent obstetrician Sir James Y. Simpson of Edinburgh met cases of hemorrhage in the newly-born which he attributed to inflammation of the vessels, arterial or venous, or both, from which the blood escaped. The inflammation, in his opinion, caused thickening and infiltration in the walls of the vessels, loss of tonicity, and consequently a patulous state. Simpson does not seem to refer in particular to the hemorrhage due to syphilis, but to that from other causes as well. Dr. Mracek, lecturer on syphilis in the University of Vienna, reported 19 cases of hemorrhagic syphilis in neonati.[1] None of the mothers had undergone antisyphilitic treatment. One of the infants was born dead, while the others lived from half an hour to forty-eight hours. The capillaries, the vasa vasorum, the venules, and arterioles were filled with morbid products, having caused local troubles of circulation and sanguineous effusions.

Among the first to draw attention to hemorrhagic syphilis of the newly-born was Behrends in 1883, whose opinions were based on clinical observations. His views received support and confirmation from cases observed by Kassowitz, Dreahma, and Emilio Shutz. The last physician made careful microscopic examination of the vessels in infants who died of this hemorrhage. Andronico also published an interesting paper on hemorrhagic syphilis of the newly-born.[1] His observations justify, in his opinion, the statement that hemorrhages in syphilitic neonati are due not only to "diminished power of coagulation of the blood," but to a "vascular ectasis, particularly in the small cutaneous veins."

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[1] *Berlin. klin. Woch.*, No. 46, p. 807, Nov. 15, 1886.

Widerhofer,[2] remarking on hemorrhage in the syphilitic infant, attributes it to the blood dyscrasia.

Bleeding from the navel also sometimes occurs as a symptom or complication of jaundice. Writers who have collected records of this hemorrhage have remarked the frequent occurrence of the icteric hue both before and during the bleeding, even in those who do not present the history of syphilis. It is not improbable that in certain instances the jaundice is hæmatogenous, arising from destruction of the red globules and liberation of the hæmatin—a not unusual result of a profound dyscrasia even when there is no syphilitic taint. In other instances the jaundice proceeds from the liver, and the bleeding occurs from the altered state of the blood, which is produced hy abnormalities in the liver or its appendages. Thus in at least five of the cases of umbilical hemorrhage collated by Jenkins the marked jaundice which was present was found to be due to congenital occlusion of the common bile-duct, and of course all the bile secreted which did not remain in the liver entered the blood. The biliary acids in the blood probably diminish the amount of its fibrin and increase its fluidity.

Poor health in the mother and impoverishment of her blood during gestation, whether from chronic disease, as tuberculosis, or antihygienic conditions, also cause impoverishment and increase the fluidity of the blood, and therefore act to a certain extent as a predisposing, if not as a direct, cause of the hemorrhage. Some have supposed that the excessive use of diluent drinks or alkalies by the mother during gestation also increases the fluidity of the blood of the fœtus and renders it more liable to hemorrhages after its birth.

In exceptional instances no adequate cause of the bleeding can be detected either in the child or the health of its parents. Thus in the *Archives of Pediatrics* for May, 1884, Dr. Seibert relates the case of an infant whose umbilical dressing and clothing were saturated with blood at the twentieth hour after birth. The bleeding was arrested, but it returned, and the child died. No coagula of blood occurred either in the pools or the saturated clothing. There was no history of hæmophilia or syphilis in the parentage or lineage, and the child at birth was plump and apparently healthy, having no petechiæ, pemphigus, jaundice, or ecchymoses. The health of the mother had not, however, been good during gestation.

Ordinarily, umbilical hemorrhage occurs without premonition, but occasionally it is preceded by jaundice. Jaundice was a prodromal symptom in 41 of the 178 cases embraced in Jenkins's statistics, and, besides the icteric hue, constipation, clay-colored stools, deeply-tinged urine, etc. were recorded in some of the cases. Rarely colicky pains and vomiting precede the hemorrhage. The blood oozes slowly or rapidly. It seldom escapes in a jet, even when its color shows that its source is more arterial than venous.

Grandidier collated the histories of 202 cases, and the examination of these enables him to make the following statement: The hemorrhage often begins at night, so that it may continue a considerable time before it is detected. He also states that vomiting, colicky pains, somnolence, and especially icterus, with constipation or clay-colored stools, sometimes occur. In 135 of the cases embraced in Grandidier's statistics the hemorrhage occurred in 38 before the fall of the cord, in 26 at the time of its separation, and in 71 at a later date.

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[1] *Arch. di Pat. Infan.*, July, 1886.

[2] *Allgem. Wien. med. Zeitung*, No. 4, 1883.

PROGNOSIS.—This is unfavorable. Statistics show that 5 in every 6 perish. The prognosis is most unfavorable when an obvious dyscrasia is present. Those who have jaundice or hæmophilia with very few exceptions perish. Those are most likely to recover who have a healthy parentage, no obvious dyscrasia, and in whom the hemorrhage occurs late and is not profuse. The average duration of the hemorrhage in 82 cases in Jenkins's collection was three and a half days, the minimum being only three hours. Death usually occurs from exhaustion.

TREATMENT.—A compress of surgeon's lint or a sponge saturated with the liquor ferri subsulphatis should be firmly pressed over the umbilicus and retained by a bandage. If the bleeding do not cease, the umbilicus should be covered by a thick layer of plaster of Paris, supported by the hand until it hardens, and then retained in place by the bandage passing around the body. In the case related above, occurring in my own practice, this treatment arrested the bleeding from the navel, but it was followed by fatal intestinal hemorrhage. If the hemorrhage continue, the needles with ligature may be employed. Bouchut indeed states that this is the only effectual treatment. Two needles are passed through the umbilicus at right angles, and a waxed thread wound around each in the form of the figure 8. If the patient survive, the needles should be removed in four or five days and iodoform or a poultice applied. It is important, so far as time will permit, to treat the dyscrasia, and a laxative is often indicated, especially if constipation be present. A laxative is useful for its effect on the hepatic circulation and as a derivative. Both Smith and Jenkins recommend calomel for this purpose. During the continuance of the hemorrhage four or five drops of brandy in breast milk frequently administered are useful as a stimulant.

CHAPTER III.

DISEASES OF THE NEW-BORN (CONTINUED).

ICTERUS NEONATORUM.

ICTERUS, or a yellowish discoloration of the skin, is common in the newly-born. It has even been said that in its mildest form it is present in the majority of infants, and it arises from a considerable number of anatomical and pathological conditions. It occurs in its worst and most intractable form when there is congenital obliteration of the bile-ducts; it is believed to occur sometimes in the youngest infant from the same cause as that which produces the usual form of adult jaundice—to wit, catarrh of the duodenum extending by propagation into the bile-ducts and narrowing or occluding their lumina. Congenital syphilis is another cause, the icterus being probably produced by the newly-formed connective tissue which compresses the bile-

The *modus operandi* of the causes related above is easily understood,
portion of the neonati who have the icteric hue in a slight or
ppear sick, and fully recover after a few days. The cause
bly of a trivial nature, else it would produce a more
e system. West says of these mild cases in which
nent of the health that the yellow tinge of the

skin comes on about the third day, deepens for a day or two, and subsides gradually, "the bowels acting properly and the urine not being high-colored: though to this condition the name of jaundice has been applied, it is yet no real jaundice, but is merely the result of the changes which the blood in the over-congested skin is undergoing, the redness fading, as bruises fade, through shades of yellow into the genuine flesh color." A yellow coloring of the skin, the result of cutaneous hyperæmia, is not accompanied by the diagnostic signs of true jaundice, such as a yellow conjunctiva, clay-colored stools, and biliary coloring matter in the urine. Inasmuch as the liver and other internal organs are not concerned in producing this form of icterus, West says it has been proposed to designate it by the term "local icterus." It would be interesting to ascertain in cases in which there is a deposit of pigment in the skin, while all the other organs, including the liver, are in their normal state and have their normal functional activity, whether there has been a cutaneous plethora due to late ligature of the cord. Zweifel states that the placenta before the uterus contracts after the expulsion of the child, and the cord is still beating, contains six ounces of blood, but if the cord have ceased to beat and the uterus be firmly contracted, half of this amount of blood, or three ounces, passes through the cord and augments to this extent the quantity of blood in the vessels of the fœtus. Late ligature, therefore, when there is firm uterine contraction, increases the fulness of the blood-vessels in the child, and, according to Park, babies with distended blood-vessels exhibit a more intense jaundice.

H. Quincke advances another and in some respects a plausible theory of the etiology of the common form of icterus neonatorum.[1] He attributes the jaundice to the continued patency of the ductus venosus. Henry Ashby says[2] that in a minority of cases of jaundice of the new-born the clinical history or post-mortem examinations reveal the cause, as when it arises from congenital defects, syphilitic hepatitis or cirrhosis, septicæmia or hæmaglobinuria. But the usual form of infantile jaundice, which begins on the second or third day, and commonly ends favorably, Ashby states, has nothing in common with the above fatal forms. He does not accept West's and Murchison's theory of a merely cutaneous icterus, and believes that Quincke's theory is the most plausible yet presented for consideration. The ductus venosus normally closes between the second and fifth days after birth, but if it remain pervious and the circulation from any cause be retarded, bile, according to the above theory, enters the branches of the portal vein and finds its way into the general circulation through the ductus venosus. In one case, says Ashby, an infant had jaundice from the second to the eleventh day, and at the autopsy the ductus venosus was large enough to admit an ordinary director. This theory also comports with the fact that feeble infants are more liable to become jaundiced than the robust, for those vascular canals which pertain to the fœtal state and are obliterated after birth are more likely to remain a longer time pervious in the feeble than the robust.

Dr. Alois Epstein[3] made many experiments in order to determine whether bile-pigment occurs in the urine of icteric newly-born infants. He agitated the urine with lime-water, filtered it with alcohol, and added sulphuric acid. If bile-pigment be present a green color results. He discovered in the urine a pigment in the crystalline or amorphous state, and of a yellow or yellowish-red color. It occurred in the various forms of tufted needles or small tables, yellowish or brownish, and in yellowish-red amorphous granulations. Epstein was able to distinguish by chemical reactions this pigment from uric acid and the urates. On further investigation he states that he found this pigment in all the organs, abundantly in the kidneys, and also in the blood. Does this pigment have an hepatic or hæmic origin? Epstein is led by his investigations to believe that this crystalline or amorphous pigment results from changes occurring in the blood, and probably from the liberation of the coloring matter by the destruction of the red corpuscles, which Neumann, Kölliker, Denis, Hayem, and others have shown to occur so abundantly in the neonati.

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[1] *Archiv für experimentelle Pathologie und Pharmakologie*, xix. 1 and 2.

[2] *Lond. Med. Times and Gaz.*, April 25, 1885.

[3] "Ueber die Gelbsucht bei Neugeboren Kindern," *Sammlung klinischer Vorträge*, No. 80, 1880.

Epstein believes that any marked impairment of the important functions in the system tends to increase the destruction of the red corpuscles, the consequent release of its coloring matter, and the formation of the crystalline or amorphous pigment described above, which in icterus escapes into the tissues. Marked impairment of respiration, circulation, and calorification, artificial alimentation, prematurity, protracted and difficult birth, taking cold, and similar agencies, in proportion as they impair the general health and produce perturbation in the system, increase the destruction of red corpuscles, and thereby act as causes of icterus. Epstein also mentions the well-known fact that the children of parents who have grave constitutional diseases or live under bad hygienic conditions are especially liable to become icteric, and that septic infection is an important cause of those alterations in the blood which give rise to icterus.

The peculiar character of the blood of the newly-born is believed by good observers who have investigated this subject to predispose to the occurrence of jaundice. According to Hofmeier, the red blood-corpuscles in the neonati are more spherical than in adults, and do not show a tendency to form rouleaux. The white corpuscles are often more numerous than in adults; they are viscid, deliquescent, easily destroyed, and have a tendency to aggregate in rouleaux. The investigations of Ponfick and Silbermann[1] show that the red corpuscles of the new-born readily part with their coloring matter. the hæmaglobin, under disturbing agencies, such as syphilis, burns, taking cold, injudicious nursery management, and even by the action of certain medicinal agents, as glycerin and pyrogallic acid. The red corpuscles, which have lost their coloring matter by its transference to the plasma, either disintegrate and disappear, or they appear under the microscope as pale rings which have been designated shadows. This transference of the coloring matter from the red corpuscles to the liquor sanguinis, and the disintegration of red corpuscles, which characterize the first few days of infant life, lead to an increase of hæmaglobin in the plasma (hæmaglobinhæmia) and of fibrin ferment. Silbermann summarizes his views, derived from an examination of the character of the blood and the blood-changes occurring in the newly-born, as follows: "The blood of the newly-born holds corpuscles which vary greatly in size, and also the so-called shadows: it is richer in fibrin ferment than the blood of adults; these peculiarities are due to the liberation of hæmaglobin and its transfer into the plasma; the richness in fibrin ferment of the blood of the newly-born predisposes to disease; all disease-processes in the newly-born which involve great destruction of the albumen in the circulation are especially dangerous to life." These investigations relating to the blood will aid to an understanding of the views of Silbermann regarding icterus.

Dr. Silbermann concludes[2] an elaborate paper on icterus neonati with the following aphorisms: "1st. Icterus of the newly-born is an icterus of absorption. 2d. The biliary engorgement has its seat in the biliary capillaries and the interlobular bile-ducts, which are compressed by the dilated branches of the portal vein and the capillary blood-vessels of the liver. 3d. This engorgement in the vessels is effected by the change in the circulation of the liver which occurs soon after birth, and is one of the indications of a general change in the blood-plasma. 4th. This change, which is induced by the destruction of many blood-corpuscles soon after birth, consists of a kind of blood-fermentation. 5th. The more feeble the infant the more intense will be the icterus, for in such a child the destruction of corpuscles, and the consequent blood-changes, will be much more decided than in a vigorous child. 6th. As the consequence of the destruction of so many red corpuscles there is abundant material for the formation of biliary coloring matter, and under the influence of the fermentation-process alluded to this accumulates in considerable quantity." Therefore, according to this theory, free coloring matter in the blood, derived from the abundant destruction of the red corpuscles which attends the first days of infancy, occurs in such quantity that it cannot be disposed of in the biliary secretion or otherwise eliminated, and is deposited in the tissues, causing the icteric hue.

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[1] "Zur Hämatologie der Neugeborenen," *Jahrbuch für Kinderheilkunde*, 1887.

[2] *Archiv für Kinderheilkunde*, 1887.

Birch-Hirschfeld[1] attributes icterus of the new-born to œdema of the capsule of Glisson, and consequent compression of the bile-ducts. This œdema he believes is due to diminution of pressure in the portal system consequent on section of the cord.

That feebleness, insanitary conditions, and exposure are a cause of jaundice, however they may act to produce such a result, is shown by many observations. West, as we have stated above, describes a local or cutaneous icterus resulting from plethora of the skin, and having no special interest or importance, and a systemic or general icterus, which he states "does not affect perfectly healthy children who have been born at the full time, have been nourished exclusively at the mother's breast, and been sheltered from cold without being overburdened with clothing or confined in a vitiated atmosphere." In corroboration of this statement he alludes to the fact that in the Dublin Lying-in Hospital, where the utmost care is bestowed on the foundlings, icterus is rare, while it is so common in the Foundling Hospital of Paris that few escape. In the latter institution, as compared with the former, the exposures are much greater and the conditions as regards hygiene are greatly inferior.

M. Bouchut says that icterus is observed in 80 to 90 per cent. of the new-born; that Levret, Breschet, Billard, and Valleix regard it as the result of ecchymosis of the skin following congestion—an opinion which he considers erroneous. He believes that it almost always results from a mild or severe hepatitis consequent on ligature of the cord. The ligature, he says, produces a mild inflammation which is propagated to the liver and causes obstruction of the bile-ducts. In his articles on hepatitis of the new-born he repeats his belief in this theory.

The obvious inference from the above résumé of opinions is that icterus neonatorum results from different causes in different instances, and that it is a mild or grave disease according to its etiology. The various causes admit of classification in two groups: 1st, the hæmatogenous; 2d, the hepatogenous. The hæmatogenous theory, which attributes the common form of icterus of the newly-born to the destruction of the red blood-corpuscles in the first days of life, and the escape of the coloring matter into the circulation, is advocated by such men as Billard, Virchow, Breschet, Porak, Violet, and Epstein. The hepatogenous theory has also advocates of equal reputation. The etiology of this disease certainly requires further investigation, and when yellowish or brownish, and in yellowish-red amorphous granulations. Epstein was able to distinguish by chemical reactions this pigment from uric acid and the urates. On further investigation he states that he found this pigment in all the organs, abundantly in the kidneys, and also in the blood. Does this pigment have an hepatic or hæmic origin? Epstein is led by his investigations to believe that this crystalline or amorphous pigment results from changes occurring in the blood, and probably from the liberation of the coloring matter by the destruction of the red corpuscles, which Neumann, Kölliker, Denis, Hayem, and others have shown to occur so abundantly in the neonati.

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PROGNOSIS.—This depends on the nature of the cause as well as the present state of the infant. If the cause be susceptible of removal, as in the common mild form of icterus, a favorable prognosis is justified. The most unfavorable cases are those in which there is absence of the biliary ducts or their permanent occlusion. In severe forms of the disease in which the connective tissue, the secretions, and transuded serum have the yellow hue the prognosis should be guarded.

The common mild form of icterus, appearing on the second or third day after birth, disappears or is scarcely appreciable at the close of the second week. Severe icterus, continuing longer without any abatement in its intensity, is due as a rule to permanent anatomical conditions which prevent the flow of bile into the intestine, and is probably incurable. In these cases the stools remain clay-colored, the icterus increases, and vomiting may occur.

The TREATMENT is simple, and to a considerable extent expectant. Gentle friction over the liver may perhaps in some cases aid in removing the obstructive disease in the bile-ducts. The use of hydrarg. cum creta in small doses, as recommended by West, is of doubtful efficacy. It is evident that preventive measures are more important and more efficacious than the curative, since every measure which promotes a healthy parentage and the health and robustness of the infant tends to diminish the frequency of this disease. Those who, like Porak, believe that congestion of the skin at birth is a common cause of the simple form of jaundice recommend an early ligature of the cord, when the umbilical arteries are still beating or have just ceased to beat, since when the arteries are beating an equilibrium is maintained in the circulation, whereas in a late ligature, when the uterus is firmly contracted and the arteries have for some time ceased to beat, a plethoric state of the vessels is more likely to occur.

SEPSIS OF THE NEW-BORN.[1]

The manner in which sepsis or septicæmia occurs is sometimes obscure. Leube in 1878 relates two cases[2] in which the examination failed to disclose the source or mode of infection. He designates such cases cryptogenetic, expressive of the unknown or occult origin. Wunderlich and Schützenberger allude to similar cases. But in sepsis of the newly-born it is the common and apparently correct belief that the poison of sepsis usually enters the system at the umbilicus. The cases which I am about to relate are in harmony with this theory.

It is not my intention to discuss the nature of the septic poison, but there can be little doubt, from the examinations which were made, that in the following cases it consisted of microbes and the ptomaïnes or chemical agents produced by microbic action.

Cases of sepsis of the newly-born may be conveniently classified as follows:

FIRST GROUP.—*Cases of umbilical phlegmon, which is a local sepsis, the poison entering the system from an umbilical sore, and being conveyed by the lymphatics.*

The New York Infant Asylum at Sixty-first street and Tenth avenue has, during the twenty-three years of its existence, been remarkably free from contagious and infectious diseases, but since September 1, 1887, seven cases, in which either local or systemic sepsis was diagnosticated, occurred in new-born infants in the maternity ward of this institution. It is proper to state that at the same time diphtheria was epidemic in the asylum, and that five of the newly-born infants had diphtheria, the pseudo-membrane appearing in its usual situation on the pharyngeal, nasal, and laryngo-tracheal surfaces, and, in one or two of the patients, also lining the œsophagus. Moreover, two of the five infants with diphtheria had umbilical phlegmon of a few days' duration when the diphtheritic exudate appeared upon the faucial surface.

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[1] Read before the Pædiatric Section of the New York Academy of Medicine, *Medical News*, Sept. 8, 1888.

[2] *Deutsch. Archiv für klin. Med.*

The question is therefore a proper one, whether in these two cases the phlegmons were a local manifestation of diphtheria, or whether the umbilical phlegmon and diphtheria were distinct diseases having a different microbic origin.

CASE 1.—Victor M—— was born, after normal labor, on January, 5, 1888, and the umbilicus was dressed with borated cotton. The mother did well, and was able to leave her bed on the seventh or eighth day. Nothing unusual was noticed in the infant until January 11th, when a little suppuration was observed in the umbilical fossa at or around the point of attachment of the cord, and on examination the walls of the umbilicus were found thickened and indurated. The appearance indicated the commencement of an umbilical phlegmon, and the skin covering it was red as in erysipelas. The phlegmon extended in area until January 14th, when the thickening and infiltration reached to the distance of about one and a half inches in every direction from the umbilicus, so that the form of the phlegmon was circular or wheel-shape. Its thickness or depth near the umbilicus was perhaps three-fourths of an inch, but near its margin the thickening and infiltration were less. The pulse on the 13th varied from 132 to 144, and the rectal temperature was 101.8°.

The case was carefully watched by Drs. Davis and Cook, the resident physicians, whose records I employ, and the faucial surface was daily inspected by them. On January 14th, the baby being nine days old, they observed for the first time the grayish-white exudate of diphtheria on each side of the fauces, and a day or two later also upon the Schneiderian surface, so closing the nostrils that respiration through them was impossible. The baby, on attempting to draw the nipple, became cyanotic and was obliged to relinquish its hold. During the 14th and 15th the temperature fell to 98.5° and 98°, the pulse was very feeble and too rapid to be counted accurately, and the respiration varied from 24 to 48. Death occurred on the 15th at the age of ten days.

The autopsy revealed a diphtheritic pseudo-membrane upon the faucial surface on both sides, extending downward, so as to cover both surfaces of the epiglottis, the entrance of the larynx, and the laryngeal surface, completely concealing the vocal cords and the portion of the larynx above them. The trachea and bronchial tubes were free from the exudate. The lungs in nearly every part were thickly mottled with points of extravasated blood, and less abundant extravasations were observed in and upon other organs. The umbilical phlegmon, removed entire, and in a frozen state from the intensity of the cold in the dead-house, was sent to the laboratory of the College of Physicians and Surgeons, where it was carefully examined by Dr. Prudden. He reports that the umbilical vessels were in their normal state, showing no evidence of disease, except the mouth of the umbilical vein or that portion of the vein which was next to and in immediate relation with the umbilicus. Plugging the mouth of the vein and extending a few lines along the lumen of this vessel was a thrombus or blood-clot, from which Dr. Prudden was able to obtain cultures, and in the culture-bed two forms of cocci were developed—to wit, the staphylococcus pyogenes aureus, occurring in the usual form in groups, and the streptococcus pyogenes, producing beautiful and delicate chains. The portion of the vein enclosing the thrombus or clot had preserved its integrity, so that the clot was entirely distinct from the phlegmon which covered the vein. It did not seem possible that microbes, ptomaïnes, or elements of the blood could pass from one to the other, on account of the firm coats of the vein which were interposed between them.

Portions of the phlegmon placed in culture media developed the same forms of cocci as those produced from the clot that plugged the mouth of the vein. We infer that the cocci were the septic agents, since no other cause of the sepsis was discovered, and that they were received from the umbilical sore. Some entered the thrombus, and others, taken up by lymphatics, entered the tissues which surrounded the umbilicus and gave rise to the phlegmonous inflammation.

It is easy to understand how micro-organisms may enter the umbilical vein after the fall of the cord, when there may not be complete closure of the mouth of the vessel. But it can scarcely be doubted that in the above case, as well as in cases which I am about to relate, the septic infection took place through the raw and denuded surface of the umbilical fossa, the lymphatics being the carriers of the poison. We know how frequently granulations sprout out from the umbilicus of the new-born, and wherever there is a surface denuded of cuticle from which these may arise there is a surface from which microbes or toxic agents may be absorbed. The umbilicus, too, is a receptacle in which microbes, conveyed in the floating dust of an apartment, in foul water used for bathing, in dirty sponges, or abdominal binders or umbilical dressings, would be likely to lodge. M. Bouchut, in his remarks on the fall of the umbilical cord, says: "Cords voluminous, soft and plump, dry slowly and often suppurate at their base before they fall (les cordons volumineux, mous et gras, se dessèchent lentement et suppurent souvent à leur base avant de tomber)."[1] With conditions so favorable for septic infection it is perhaps surprising that it does not more frequently occur, especially in hospital or asylum wards.

The patient whose case I have related evidently had systemic infection in addition to the local septic infection in the phlegmon. The numerous points of extravasated blood in the lungs and elsewhere showed this. But doubt must arise whether this general infection occurred from the phlegmon, in which there was intense hyperæmia and an active circulation, as shown by the inflammatory redness of the cuticle, or whether it resulted from and was connected with the diphtheria. But we will relate cases of systemic infection in which there was no diphtheria and in which the septic agent or agents entered the system through the umbilicus.

The volume of the *Transactions of the London Pathological Society* for 1879 contains an able and elaborate report of the committee appointed by that society to investigate pyæmia, septicæmia, and purulent infection. Their report is based on the examination of the records of 156 cases occurring in the London hospitals, and it throws light on the cause of hemorrhagic extravasations occurring in cases of septic infection of the system. They remark: "On microscopical examination of different organs, micrococci were found in all, or at least in some, of the viscera. They were nearly all in the blood-vessels, completely plugging the capillaries; in masses which sometimes produced varicosities, or even rupture of the vessels, and extended into the contiguous tissues."[2]

CASE 2.—Hilda M——, born February 28, 1888, was plump and robust, weighing eight pounds and seven ounces. The mother appeared to be well until March 3d, when she had fever and symptoms which were apparently due to pelvic cellulitis, probably of septic origin. The infant was fretful on March 3d and 4th, and on March 5th a small ulcer was observed in the umbilical fossa. The skin surrounding the umbilicus, over an area the size of a silver dollar, had a deep-red color, and the tissues underneath, constituting the abdominal walls, were infiltrated and thickened. The phlegmon gradually extended in every direction from the umbilicus, so that on March 6th it nearly reached the ensiform cartilage above and the pelvis below. The fauces had been inspected daily, and at 5 P. M., March 6th, the grayish-white exudate of diphtheria was observed for the first time, covering the tonsillar portion of the fauces on each side. On March 7th the exudate had increased, the cry was hoarse, the fingers livid at times, and fluid regurgitated through the nostrils. The phlegmon occupied nearly the entire abdominal walls anteriorly. March 8th, surface cyanotic; respiration labored, and at times accompanied by the expiratory moan; a diphtheritic pseudo-membrane in the right nostril. Death occurred at 6.30 A. M., March 9th, at the age of ten days, on the fourth or fifth day of the phlegmon and on the third day of the diphtheritic exudate upon the fauces. The rectal temperature varied from 99.8° to 102.8° until the last day, when it was subnormal, being 96.6°; the pulse varied from 99 to 112, and the respiration from 40 to 60. Both the pulse and respiration gradually increased in frequency until death, this increase being probably largely due to the double pneumonia. The tincture of the chloride of iron in glycerin, brandy, and breast-milk were given internally, iodoform and carbolized oil applied to the umbilicus, and antiseptic sprays employed for the fauces and nostrils.

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[1] *Traité pratique des Maladies des Nouveau-nés*, etc.

[2] *Brit. Med. Jour.*, January 24, 1880.

Prof. T. M. Prudden kindly consented to conduct the autopsy, which was made with sterilized instruments and under conditions designed to prevent access to the body of adventitious germs. The following are his notes:

Autopsy.—The umbilical orifice was covered by a dry, brownish scab, beneath which was a small, rough-edged cavity containing a yellowish semi-solid mass. The abdominal wall, for about three centimetres around the umbilicus on all sides, was hard, thickened, and dusky red. A section through the abdominal wall in the line of the umbilicus showed that the wall was thickened to about 1.5 centimetres immediately around the latter.

Both the umbilical vein and the hypogastric arteries, to the distance of about 1.3 centimetres from their attachment to the abdominal wall, were much thickened, red and hard, and their inner layers were converted into a soft, yellowish, friable material. Beyond this point all of these vessels were filled with blood-clots and appeared healthy. There was no peritonitis, and all of the abdominal organs were normal.

The heart was normal. The pharynx, larynx, and trachea showed soft, reddish friable patches of diphtheritic membrane partially covering their free surfaces. This membrane did not extend into the bronchi. The lungs exhibited broncho-pneumonia in both lower lobes, with considerable consolidation.

The microscopical examination of the parts about the umbilicus showed that at the point of attachment of the cord was a small pus-cavity whose walls were infiltrated with small spheroidal cells, with a few rod-like bacteria and with large numbers of spheroidal bacteria. Similar spheroidal bacteria were found in the purulent detritus contained in the cavity as well as within the lumina, and infiltrating the walls of the adjacent ends of the umbilical vein and the hypogastric arteries.

The tissues of the abdominal walls about the umbilicus were infiltrated with serum, fibrin, and a moderate amount of pus. Spheroidal bacteria were rather scantily scattered in the lymph-spaces of the swollen tissues, being most abundant near the umbilical vessels.

Biological examination of the contents of the inflamed portion of the umbilical vessel showed the presence of several species of bacteria. The species which was by far the most abundant was readily identified as the staphylococcus pyogenes aureus.

The anatomical diagnosis, then, is diphtheria of the pharynx, larynx, and trachea, with double broncho-pneumonia, localized septic inflammation of the umbilical vein and hypogastric arteries and of the abdominal wall surrounding them.

As the evidence of local infection is so great, it seemed desirable to gain some data as to the purity of the air in the wards. Accordingly, such analyses as time permitted were made by Dr. T. M. Cheeseman, Jr., who presented the following report: " A biological examination of the air in the lying-in ward of the New York Infant Asylum, made on March 7, 1888, showed a very large number of living bacteria of many different kinds. Among them the staphylococcus pyogenes aureus was of frequent occurrence. A second examination, made immediately after the usual sulphur disinfection, showed a large number of living germs."

Case 3.—Janse J——, born January 3, 1888, was wet-nursed by its mother, and apparently did well until January 16th, when the attention of the resident physician was directed to it, and an umbilical phlegmon was discovered as large as a twenty-five cent piece, the skin covering it being intensely red; temperature 98.5°. The dressing, after the discovery of the phlegmon, consisted in dusting with iodoform and the application of carbolized oil (one part of carbolic acid to twenty-five of sweet oil). January 17th, phlegmon not extending and its surface less red. The redness, thickening, and infiltration gradually abated, and on January 21st the patient was removed from quarantine. In this case there was no record of an umbilical sore; the fauces remained normal, so that the diagnosis of diphtheria was excluded. The mother continued well.

Case 4.—George C—— was born in the maternity ward January 14th. On January 25th the nurse observed a small vesicle upon the border of the umbilicus, and removed the cuticle covering it. Some hours afterward the attention of the resident physician, Dr. Davis, was called to it, who found thickening and infiltration of the umbilical wall, most marked on the side which had been occupied by the vesicle. The same treatment was employed as in Case 3. The records of January 26th and 27th state that the redness and infiltration are abating, and on the 29th the umbilicus had returned to the normal state.

Case 5.—John S——, born October 14, 1887, the mother being a healthy primipara. The child was well developed at birth, weighing nine pounds and four ounces. The cord fell on the sixth day, and a small ulcer with indurated edges was observed in the umbilical fossa at the point of attachment of the cord. The induration in and around the umbilicus increased slowly until the ninth day. On the ninth day the child was restless, and on examination the ulcer was found enlarged and surrounded by a zone of inflamed tissue half an inch in width. The inflammation, accompanied by the usual infiltration and swelling, gradually extended, so that on the 15th the diameter of the inflamed area was two inches. The ulcer had also increased. On the twentieth day after birth the ulcer had attained the diameter of two inches and the depth of three-eighths of an inch, but the induration had begun to abate. From this time improvement was progressive, and no notes were taken after the twenty-fourth day. The rectal temperature, ascertained each day from the ninth to the twenty-fourth day, varied from the normal to 102°. During the active period of the phlegmon it was usually from 100° to 101.5°, and the emaciation was progressive, the loss of weight being estimated at two pounds. The treatment consisted in dusting with iodoform and the use of a compress of absorbent cotton soaked with a solution of carbolic acid. During the second week, under the advice of the attending physician, Dr. George B. Fowler, calomel was also dusted on the sore. On the twenty-fourth day the infant was removed to the Post-Graduate School, and its subsequent history is unknown. The mother had no unfavorable symptom.

Case 6.—Joseph D——, born October 22, 1887, well developed, weighing seven pounds thirteen ounces. The cord fell on the eighth day, leaving a small ulcer at its point of attachment with an indurated border. Two days later, the tenth day after birth, the ulcer had increased slightly, being one-quarter of an inch in diameter. The surrounding tissues to the distance of one inch were thickened and indurated from inflammation. At no time was the temperature above 99.1°, and the child, though restless, nursed well. The tumefaction and hardness surrounding the umbilicus remained about the same until the sixteenth day, after which they gradually abated. The ulcer had healed at the end of the fourth week. The mother on the third day after confinement had elevation of temperature which continued four days; and six weeks after the birth of the child she had diphtheria in the usual form. During the same month—October—twenty-seven obstetrical cases were under observation, but all except this patient convalesced without any unfavorable symptom.

Second Group.—*Cases in which the septic poison probably entered the system through the umbilical vein.*

Case 1.—In May, 1884, an infant died of sepsis at the New York Infant Asylum at the age of fifteen days. It was apparently well until about the close of the first week, when the umbilicus was observed to be raw, and a slight oozing of a puriform liquid occurred from it. During the second week the abdomen was hard and tender, and peritonitis was diagnosticated. The cord fell on the seventh day. During the second week the abdomen was apparently painful; the temperature three days before death was 100.6°, and two days before death 102.4°. Examination of the chest gave a negative result. The post-mortem examination was made by Dr. W. H. Welch, now professor of pathology in Johns Hopkins University. The abdomen contained six ounces of turbid serum with flakes of fibrin. The portion of the peritoneum covering the umbilical vein and along the under surface of the liver, especially at the transverse fissure, was covered with fibrin, but the peritoneum generally did not exhibit any notable hyperæmic or inflammatory appearance. Lymphatic vessels filled with purulent-appearing substance could be seen in the under surface of the diaphragm, showing in what way septic infection extends along the lymphatics. The lymphatics of the diaphragm open upon the pleural surface, and it is probable, had the patient lived longer, that septic pleuritis, perhaps on both sides, would have occurred. The umbilical vein was filled from the umbilicus to the transverse fissure of the liver with a grayish softened detritus consisting of broken-down thrombi with a considerable proportion of pus. Softened thrombi could be traced the entire length of the umbilical vein, the walls of which were thickened and infiltrated from inflammation. No thrombi were seen in the portal vein or vena cava; the pericardium contained more than the normal amount of serum with flakes of fibrin; hemorrhagic points were observed in the posterior portions of the lungs under the endocardial surface, under the peritoneal coverings of the kidneys and mucous covering of their calices. The mother did well, giving no evidence of disease of any kind.

CASE 2.—This infant, born in the New York Infant Asylum, the date not being given, was well developed at birth, weighing eight pounds six ounces. When four or five days old it became feverish, the temperature rising to 104.6°. The cord separated at the usual time, and the umbilicus seemed healthy. At the age of two weeks an abscess appeared upon the scalp, another upon the back, and another upon the nates, which raised the suspicion of septic poisoning. At the age of four weeks orchitis on one side occurred, which continued three weeks, when it abated. When the child was two months old a prominence appeared about half an inch above the umbilicus, which Dr. Parker, the resident physician, punctured, and bile flowed from the incision. Subsequently the incision closed, and bile flowed from the umbilicus, and continued to flow until death, which occurred, in a state of much emaciation and weakness, at the age of eight months.

At the autopsy, made by Prof. Welch, remains of old abscesses were found upon the trunk and extremities, and an abscess holding four drachms of pus was found over the occipital bone. Underneath the abscess the bone was carious and the dura mater thickened. The umbilical vein was much larger than normal, its walls being infiltrated and thickened, and its lumen of about twice its usual diameter. It contained thickened bile. One of the branches of the vein, traced into the liver, opened into an abscess the size of a walnut, which contained thickened pus with bile. The abscess was in the right lobe near its posterior border. The mother remained well.

CASE 3.—Lizzie C——, born September 21, 1887, robust, weighing eight pounds, seemed well, taking the breast and having normal evacuations, until September 28th, when she became restless and refused the breast. Her temperature, rectal, was 101.4°, and her respiration was accelerated and accompanied by the expiratory moan. September 29th, temperature 103.6°; respiration accelerated and painful and abdomen distended; no cough. The diagnosis of peritonitis, probably of septic origin, was made, but the umbilicus was of usual appearance, and the desiccation and fall of the cord seemed normal. The elevation of temperature, even to 104.4°, the distension of abdomen, and the hurried respiration with expiratory moan continued until death, which occurred September 30th.

At the autopsy three ounces of sero-purulent liquid containing flakes of fibrin escaped from the peritoneal cavity. All the abdominal organs were covered by a fibrinous exudation, the intestines being matted together by it. The umbilical vein was pervious; it contained clots of blood and dirty-looking pus, but the umbilicus was apparently normal. A segment of the aortic valve was thickened and rigid, and attached to it was a fibrinous mass. The appearance indicated an endocarditis of slight extent. Under the microscope the walls of the umbilical vein presented their normal appearance, but its dirty-looking and disintegrating contents probably contained septic matter. The hepatic cells exhibited the peculiar cloudiness observed in protracted febrile diseases. Otherwise the organ seemed healthy. In this case also the mother remained well.

CASE 4.—A. B——, born January 22, 1868; father healthy, but mother strumous, though in good health during her gestation. The infant, born after an easy labor, was apparently well at birth and it had sufficient breast-milk. When it was thirteen days old I was requested to visit it, as it had not been doing well, and I found it suffering from subcutaneous abscesses. Abscesses had occurred upon both legs, in the chest-walls of the right mammary region, in and around the metatarso-phalangeal articulations of one foot, and over both knee-joints. The child had fever, but its respiration was good until February 8th, when it suddenly had a severe attack of dyspnœa, which continued until death, ten hours subsequently. On the following day Dr. Charles A. Leale and myself made the autopsy. The body was moderately emaciated. About one ounce of pus escaped from the right knee-joint. Pus was also found in the joint of the great toe on one side, and about two ounces in an abscess under the right pectoral muscle. A thin layer of tissue constituted the internal wall of the abscess, so that had life been prolonged a few days it would probably have broken through into the pleural cavity. The right lung was completely collapsed, and the pleura lining this lung, as well as that lining the thoracic walls on the same side, was covered by a fibrinous exudation. The left lung contained the normal, or perhaps more than normal, amount of air, so that it filled the pleural cavity, but there was a small amount of fibrinous exudate upon the parietal pleura in this cavity.

The trachea and lungs attached were removed, and on practising insufflation of these organs, air escaped from three openings in the posterior part of the right lung. These openings, through which air had passed into the pleural cavity, causing collapse of the entire lung, were found on examination to have been produced by small abscesses in the tissue of the lung near its posterior surface. By the rupture of these abscesses the pus which they contained escaped into the pleural cavity, producing intense general pleuritis and pneumothorax. Numerous minute abscesses were found in both lungs, but only the three alluded to had been ruptured. It seemed certain that had the patient lived longer other abscesses would have ruptured.

CASE 5.—In the following case bacteria were found making their way along the umbilical vein at a distance from the umbilicus, and also in the tissues involved in the umbilical phlegmon. Those in the phlegmon were apparently derived from the umbilicus and conveyed by the lymphatics. This case, therefore, might be placed in the first group as well as the second:

Anne —— was born in the New York Foundling Asylum on May 18, 1888. A few days after birth, and before the cord dropped, the umbilicus was observed to be foul from secretion or exudation in it, indicating a sore at the base of the fossa. On the seventh day an umbilical phlegmon was noticed, small and confined to the umbilical walls. Three white patches were also observed on the roof of the palate near the velum, not raised and apparently not diphtheritic, resembling superficial ulcers. All the infants born in the maternity ward of the Foundling Asylum receive Credé's treatment, designed to prevent purulent conjunctivitis, one drop of a 2 per cent. solution of nitrate of silver being instilled between the eyelids of each eye. Although this child was thus treated, she had a pretty active purulent conjunctivitis of the left eye, to which our attention was now called for the first time on the seventh day. Credé's treatment was immediately reapplied to this eye, one drop being introduced between the lids. This was followed by the corrosive-sublimate treatment recommended by the late Prof. Samuel D. Gross. A solution of the sublimate, two grains to the pint, was dropped between the lids every hour to two or three hours, four or five drops being used each time. The conjunctivitis rapidly abated, and in less than a week had nearly or quite disappeared. But the phlegmon presented a very angry appearance, and the umbilical walls were greatly swollen, red, and denuded of cuticle. The inflamed area had a diameter of about four inches, with the umbilicus at the centre. Iodoform and carbolized oil were applied to the umbilicus and iron and stimulants given internally. The rectal temperature, taken May 26th, was 98°. Death occurred May 27th.

Autopsy, by Dr. W. P. Northrup, curator, thirteen hours after death.—Body well nourished; no rigor mortis; no external lesion except the umbilical; the phlegmon definitely outlined and hard, its central half brown and dry; the infiltrated abdominal wall had twice its normal thickness; peritoneal surface of phlegmon congested and adherent to omentum; from this point to the transverse colon was a leash of dilated vessels, one inch in width and three or four inches in length; peritoneum injected, and a few petechiæ observed in the parietal layer and the mesentery; mesentery deeply injected; liver and spleen normal; kidneys soft and flabby; points of hemorrhagic pneumonia in all the pulmonary lobes; abundant tenacious mucus covering the surface of the stomach and intense injection, showing acute gastritis; cerebral pia mater finely injected, but without exudation; brain normal. Diagnosis: umbilical phlegmon, peritonitis, acute gastritis, hemorrhagic pneumonia.

Microscopical and Biological Examination, by Prof. Prudden at the Laboratory of the College of Physicians and Surgeons.—The small ragged cavity at the umbilicus contained a moderate amount of pus, cell-detritus, and enormous numbers of bacteria of various forms, the spheroidal form predominating. The tissues of the abdominal wall about the umbilicus were infiltrated with fluid, fibrin, and pus; scattered about in this exudation-mass were small spheroidal bacteria. The hypogastric arteries and the umbilical vein were plugged with clots extending from one-half to three-quarters of an inch from their origin; their walls were greatly thickened by infiltration with inflammatory exudate. Both in the lumina of these vessels, along the sides of the clots, and in the lymph-spaces in their walls were enormous numbers of small spheroidal bacteria. These bacteria were present in the umbilical vein beyond the limits of the clots in the direction of the liver.

The kidneys showed moderate parenchymatous degeneration. The consolidated areas in the lungs were due to a nearly complete filling of the air-spaces and the smaller bronchi with blood.

Cultures made from the inflamed tissue about the umbilicus and from the edges of the sloughing cavity showed several species of bacteria common in the air and in the feces of children. In addition to these the staphylococcus pyogenes aureus was present in large numbers. A set of cultures from the inside of the umbilical vein, at a little distance from the sloughing cavity, revealed the presence of staphylococcus pyogenes aureus and streptococcus pyogenes, together with other forms. Cultures from the liver showed large numbers of staphylococcus pyogenes aureus, with considerable numbers of a stout bacillus similar to one abundant in the sloughing cavity. From the lung tissue from the consolidated regions enormous numbers of bacilli developed in a nearly pure culture, which corresponded in its biological characters to the bacterium lactis aërogenes of Escherich.

Remarks.—This child would thus seem to have been the victim of infection with the ordinary "suppurative bacteria" and with feces. We infer that fecal matter in some way came in contact with the umbilicus.

THIRD GROUP.—*It seems probable that in exceptional instances the septic poison in sepsis of the newly-born is received in other ways or other channels than at the umbilicus.*

If sepsis of the newly-born occur through absorption from an umbilical sore, may it not also from a sore located elsewhere? Decomposing and disintegrating animal tissue, wherever located, may be the source of septic infection. Moreover, medical literature contains histories of epidemics of puerperal fever in which newly-born infants perished with what was often designated erysipelas, but which the modern pathologist would unquestionably designate sepsis. The disease which I have described as umbilical phlegmon, a local sepsis, was commonly regarded by the older writers as a form of erysipelas. Dr. Condie, in his *Treatise on Diseases of Children*, described in the following lines what we would now designate sepsis:

"Erysipelas of infants very commonly occurs during the prevalence of epidemic puerperal fever. Children of mothers who become affected with the fever are often born with erysipelatous inflammation: others are attacked almost immediately after birth. Whether in these cases the disease is to be referred to a morbid matter applied to the skin in the womb, or to the same endemic or epidemic influence which gives rise to the disease of the parent, it is difficult to say. According to M. Trousseau, infantile erysipelas is principally observed when puerperal fever prevails in the wards of the lying-in hospitals of Paris."

The late Dr. Folsom of this city furnished me with the following sketch of cases which occurred in his practice and that of his partner. "About the year 1840, being then in practice in New Bedford, Mass., I was called to visit a man who complained of pain in the knee. The next morning he was easier, but the following evening his symptoms grew worse, and, as I was engaged in a case of obstetrics, my partner, Dr. E. C., now dead, visited him. At my call, next morning, I unexpectedly found the patient dying. The disease was obscure, and at the autopsy next day no lesion was discovered. In making the examination Dr. C. pricked his finger, and, experiencing little inconvenience from it at first, he attended a case of confinement on the following morning. A few hours subsequently he was taken sick, and I took charge of the lady, who died in three days, having the tumid abdomen and symptoms of childbed fever. The infant of the patient was seized when two days old with erysipelas appearing on the face and in spots on the trunk and limbs, and terminating fatally in one day. Dr. C.'s finger became swollen and painful, and the lymphatics of the forearm and arm became inflamed, presenting red lines, and the axillary glands suppurated. Though feverish and much prostrated, there was no appearance of erysipelas in his case. In about two weeks he resumed practice, and, as at that time physicians in this country were not fully aware of the danger of communicating puerperal fever, he attended two, three, or four obstetrical cases each week until the number reached fifteen. All the mothers died with symptoms of metro-peritonitis, and all the infants had erysipelas, commencing on the face or some part of the body, generally on the second or third day after birth, and in all terminating fatally within a week. This sad record was finally ended by the doctor's temporarily retiring from practice."

What better description could be given of a malignant form of septic infection? It will be observed that the unfortunate doctor did not have erysipelas, but inflammation of the lymphatics, occurring from the poisoned finger, and the infant who first contracted the disease and died of one day's sickness exhibited red spots upon the trunk and limbs of an erysipelatous appearance. Did the doctor poison the mothers and infants at the same time by his digital examinations? did he poison the mothers by his infected fingers, and they in turn poison the babies through the placental circulation? or did the infected mothers communicate the poison through the breath or milk? This is an interesting subject of inquiry in regard to which we are in the dark. Fortunately, the profession are now fully aware of the danger of septic infection, so that no intelligent and prudent accoucheur would attend an obstetrical case after making a post-mortem examination or visiting a case of puerperal fever without change of clothing and thorough personal disinfection, and consequently cases belonging to our third group are much more rare than formerly.

It is evident that sepsis of the newly-born might be prevented in a large proportion of instances by proper antiseptic dressing of the navel. Boric acid is a feeble and inefficient antiseptic, and the borated cotton which was employed in dressing the navel when the cases in the maternity ward occurred which have been related above was inadequate to prevent infection. Of the powders which might be prescribed for this purpose, salicylic acid or deodorized iodoform mixed with starch would appear to be much more efficient.

Credé's method of preventing purulent conjunctivitis by instilling one drop of a 2 per cent. solution of nitrate of silver between the lids has been very effectual. Probably in a similar manner umbilical phlegmon might be prevented in maternity wards by bathing daily the umbilicus with a solution of the sublimate, grs. ij to the pint.

When an umbilical phlegmon has commenced we have employed dusting with iodoform, the application to the navel every two hours of carbolized sweet oil (1 to 30), and bathing the navel with a solution of corrosive sublimate, two grains to the pint of distilled or boiled water. In some of the cases thus treated when the phlegmons were small the patients gradually recovered, but in most of the cases the phlegmons were so large, and the microbes at such a distance from the umbilicus in the tissue of the abdominal wall, that antiseptics applied upon and around the umbilicus were not curative. Newly-born infants are probably too young and feeble to be satisfactorily treated by incisions in the phlegmon and the application of antiseptics to the incised surfaces, else this treatment might be more efficient than treatment without such incisions.

THRUSH.

The terms thrush, sprue, and muguet—the last from the French—are synonymous. They are used to designate a form of inflammation of the mucous surfaces the peculiar feature of which is the presence of points or patches of a curd-like appearance on the inflamed surface. The usual seat of thrush is the buccal membrane, but occasionally it occurs on the faucial and œsophageal surfaces. It is very rare in the subdiaphragmatic portion of the digestive tube, but a few such cases have been reported by Billard and others. It never occurs upon the membrane of the nostrils, larynx, or bronchial tubes, and it very seldom occurs upon any other surface without also being present upon the buccal mucous membrane. Thrush, then, is a stomatitis, pharyngitis, œsophagitis, or gastro-enteritis with the additional element which I have mentioned.

CAUSES.—The younger the infant the greater is the liability to thrush when the causes favorable for its occurrence are present. It is therefore common in infants under the age of six weeks, and a majority of the cases occur under the age of six months. The common causes of this disease are such as ordinarily develop a stomatitis, prominent among which are improper feeding, indigestion, gastro-enteritis, and the cachectic state, whether arising from prematurity, congenital weakness, or enfeebling diseases. The most common and obvious of the causes alluded to is the use of indigestible and improper food, which produces a gastro-intestinal catarrh, soon followed by stomatitis. Thrush is therefore a common disease among foundlings in institutions where these unfortunates are received, since they not only breathe an atmosphere which is often impure, but are deprived of the mother's milk, and are so frequently given a diet which is a poor substitute for it. Infants in crowded tenement-houses of the cities and in destitute families, whose diet is often very unsuitable, are much more liable to thrush than infants well fed and well cared for in well-to-do families.

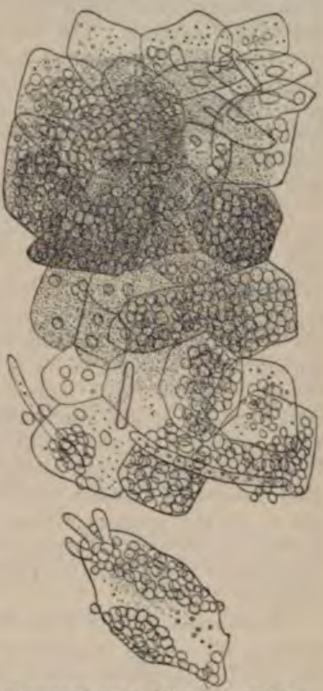
In infants under the age of three months the cause of thrush is often mild, and soon removed by better hygienic conditions and improvement in the diet. An improper diet for a few days, or a slight gastro-intestinal catarrh which quickly subsides when the cause ceases, is sufficient to develop the disease. In the newly-born the frequent use of sweetened carminatives or of sweetened dietetic mixtures administered by the nurse often gives rise to sprue, which ceases when these drinks are withheld and a proper mouth-wash applied. But after the age of six months, and especially after the age of one year, the condition giving rise to sprue is much more serious. After the age of twelve months sprue is comparatively rare, and when it does occur it is usually in the later stages of a protracted and exhausting disease; and in such cases it is an unfavorable prognostic sign. Under such circumstances it occurs even in childhood, youth, and adult life, and is justly regarded as a complication of grave import. Thrush, being a parasitic disease, is communicable by contact, like the parasite skin diseases. Thus in the wards of a foundling asylum the tip of a nursing-bottle used by different foundlings, if not properly cleaned after its use, may be the means of communicating it. Thrush is so common in young infants when the buccal surface is in a state favorable for its occurrence that it is probable that the specific germ may also be received from the atmosphere.

ANATOMICAL CHARACTERS.—The first stage of thrush is that of simple inflammation of the mucous surface. The mixed salivary and mucous secretions in the mouth, which are normally alkaline, become acid. There next appear upon the mucous surface minute semi-transparent points or granules, which, increasing, soon become white and opaque. Some of them remain as points, while others, extending and perhaps coalescing with those adjoining, form patches of greater or less extent. The white points or patches are unequally elevated. Their central part, which was first formed, is most raised, while their circumference projects but little above the epithelium. Their highest elevation is ordinarily not more than a line above the surface. They resemble closely in color and consistence portions of curdled milk, and the nurse often mistakes them for such and neglects to call attention to the state of the mouth. They are readily detached by a little force, when the mucous membrane underneath is seen to be in its integrity. Their color in the first days of sprue is white, and sometimes this color continues. In other cases they assume, if the disease be protracted, a yellowish hue.

Their true nature, long unknown, was finally revealed by microscopy. They consist in part of epithelial cells and in part of a vegetable growth. This parasite is the *Oïdium albicans*, discovered by Berg of Stockholm, but more fully described by Gruby and Charles Robin. The roots of the parasite are transparent, and they penetrate the epithelial layer sometimes even to the basement membrane. The branches arising from these rootlets divide and subdivide at an acute angle, and under the microscope are seen to consist of elongated cells with one or two nuclei. The branches or the mycelium is formed by the union of the cells at their extremities. Numerous spherical or ovoid spores are also present surrounding the mycelium and covering the epithelial cells. Haller states that he has identified this parasite with the *Oïdium lactis*, which occurs in milk undergoing acid fermentation. The spores are primarily developed, and are found in the scraping of the mucous surface in the vicinity of the patches of sprue. In two instances in examining the product of thrush removed from the œsophagus I found that the parasitic plant was the *Penicillium glaucum* or a conferva closely resembling it.

We have described the ordinary form of thrush as it occurs in young children, but if the patches are of large size and abundant, and the buccal surface generally of a deep-red color, there is usually some severe prostrating and dangerous disease on which the thrush has supervened. We have already alluded to the fact that thrush in its severe forms often results from and complicates some grave disease, as protracted gastro-intestinal catarrh or a chronic pulmonary malady. Hence some writers who have observed thrush in foundling asylums regard it as one of the most serious maladies of early life. Valleix, in a book of more than seven hundred pages relating to the diseases of children, devotes more than one-third of it to the consideration of muguet, but those pathological conditions pertaining to the digestive apparatus which most observers regard as distinct from sprue, though sustaining a causal relation to it, he includes in the description of muguet. Of 24 cases the records of which he publishes, 22 died, but their death was in most instances due to gastro-intestinal inflammation, which the author describes under the term "muguet." Most writers properly restrict, as stated above, the term thrush, sprue, or muguet to those inflammations of mucous surfaces which are accompanied by the peculiar parasitic outgrowth, regarding the severe subdiaphragmatic inflammations from which Valleix's patients died as distinct from muguet, though sustaining a causal relation to it. In the post-mortem examinations which I have witnessed in the Nursery and Child's Hospital, Infant Asylum, and Foundling Asylum of this city, of those having thrush at the time of death, who for the most part have been infants under the age of three months, I have frequently found evidences of inflammation in every division of the alimentary canal. The parasitic growth was, however, never seen below the œsophagus. Parrot, however, states that he has discovered it in rare instances in the larynx, stomach, and intestines.

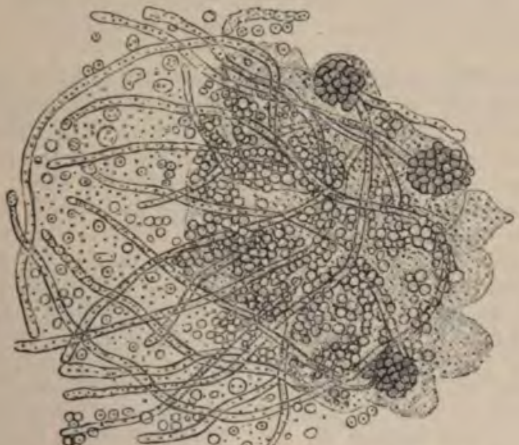
FIG. 8.



Pavement epithelium covered by spores of the *Oïdium albicans* (Ch. Robin).

SYMPTOMS.—Thrush in itself does not give rise to any symptoms except those that pertain to the surface which is the seat of the parasitic growth. Other symptoms are not referable to it, but to the diseases in the course of which it is developed and which it complicates. Sprue

FIG. 9.



Spores and Branches of the *Oïdium albicans* (Ch. Robin).

is preceded and accompanied by the symptoms of gastro-intestinal catarrh or some other disease which affects the digestive apparatus, and causes acidity of the buccal surface. The mucous membrane, upon which the cryptogam is soon to appear, becomes red, hot, tender to the touch. As we have stated above, it gives the acid reaction more or less marked to litmus-paper, and in the scraping from its surface placed under the microscope the spherical or oval spores of the *Oïdium albicans* are observed. A few hours later small white points appear, at first scarcely visible, produced by the cryptogamic growth and the epithelial and amorphous matter adherent to it.

These points enlarge, and within a day or two present the well-known appearance of small masses or patches of curdled milk. They are fragile and readily detached, but are soon replaced by others so long as the cause continues. In the worst forms of thrush the surface upon which the cryptogam appears not only presents the ordinary features of severe inflammation, such as heat, redness, and tenderness, but it is sometimes deficient in the natural secretion, so as to present a dry or parched appearance. In these severe cases there is usually in young infants obstinate and protracted inflammation of subdiaphragmatic portions of the digestive tube. The 24 cases related by Valleix, alluded to above, 22 of which were fatal, were of this kind. But the gravity of such cases, in which thirst, anorexia, restlessness, vomiting, diarrhœa, and progressive emaciation occur, is due, as stated above, to the primary disease which has produced the conditions favorable for the occurrence of sprue. If sprue occur, its symptoms should be differentiated from the more pronounced symptoms of the disease which it complicates.

Diagnosis.—This is not difficult, so far as relates to thrush of the buccal surface, for simple inspection reveals its presence. If a particle of one of the patches be placed under the microscope, the mycelium and spores of the *Oïdium albicans* are readily detected. Only the inexperienced could mistake the diphtheritic exudate for the growth of sprue or *vice versâ*. The diphtheritic pellicle penetrates the mucous membrane, from which it is detached with difficulty, leaving underneath a raw and bleeding surface, and it is thick and tough, contrasting in these particulars with the product of sprue. Enlargement of the cervical glands is also common in diphtheria and is absent in sprue.

Particles of coagulated casein upon the tongue and gums bear a close resemblance to the patches of thrush, but their relation to the mucous membrane is simply that of contact, and they are removed by a spoonful of water.

Prognosis.—The duration of thrush varies according to the duration and nature of the primary disease which it complicates. In young infants who have indigestion or slight gastro-intestinal catarrh it is quickly cured by appropriate local treatment if the nutriment given be of the proper kind and the stomach and intestines be restored to their normal state. On the other hand, thrush occurring in the course of chronic and highly debilitating diseases is not so quickly cured, or if cured is likely to return. It does not materially increase the gravity of the malady in the course of which it occurs, but when it complicates a chronic disease it indicates a reduced state of the system, an impairment of the general nutrition, which if it continue is likely to end fatally. As M. Bouchut has pointed out, when Baron states that 109 out of 140 patients with muguet died of this disease, and Valleix, as I have stated above, says that he lost 22 out of 24 cases from the same cause, they attribute to a comparatively unimportant complication what was really due to a grave internal disease. Thrush does not itself cause death, though it may be a sign of bad omen. Death when it occurs [illegible] ceral affection which precedes and accompanies the sprue, and is likely to continue after every vestige of the latter is removed by local measures, unless it receive appropriate internal treatment.

Sprue is a bad omen if the tongue and buccal surface be dry, hot, and highly injected, the coating of the tongue of brownish color, the infant fretful with the appearance of suffering in its physiognomy, and having progressive loss of flesh and strength. Such symptoms indicate in most instances a fatal form of gastro-intestinal catarrh. On the other hand, in young infants, since indigestion and slight gastro-intestinal derangements are adequate to cause an acid state of the buccal surface and the development and extension of the *Oïdium albicans*, the large majority of the cases of thrush in which the general condition is good and the stomatitis mild are quickly cured by appropriate treatment.

TREATMENT.—Since the common cause of thrush in infancy is the use of indigestible or improper food, the physician should ascertain the nature and mode of preparation of the infant's diet, and, if it be faulty, should direct one that is better. If the infant be bottle-fed, the mother's milk or that of a wet-nurse should, if practicable, be substituted for the artificial feeding; but if this be impossible, a diet should be selected which bears the closest possible resemblance to the mother's milk in digestibility and nutritive properties.

There is often in thrush an excess of acidity in the digestive tube, and an alkali is required. Trousseau recommends the addition of saccharate of lime to the milk. Children with this disease should also be taken from filthy and damp apartments to those in which the air is pure and dry, and their mouths and persons should be kept clean.

The remedy in common use in the treatment of thrush, and which is usually effectual, is borax. This, if applied sufficiently often to the affected membrane, not only destroys the parasitic growth, but prevents its reproduction. It is commonly employed with honey or in a powder with sugar or dissolved in water. The officinal mel boracis, consisting of one part of borax to eight of honey, is so much used in families that it may be considered almost a domestic remedy. There is, however, an objection to using any application for the removal of thrush which contains either sugar or honey, since either substance remaining in the mouth would rather promote the growth of the parasite. Still, it is desirable to employ a wash of such consistence that it will remain a longer time in contact with the buccal surface than will a simple solution in water. I know no better vehicle for the borax than glycerin, which has the advantage of consistence, does not undergo any chemical change, and has no unpleasant flavor. The borax may be used dissolved in glycerin, with or without some flavoring ingredient:

℞. Sodii borat., ʒj;
Glycerinæ, ℥ij;
Aquæ, ℥vj. Misce.

Borax should be used four or five times daily, and continued for a time after the disease has disappeared from sight, since the roots of the plant must be destroyed or the branches are rapidly reproduced. It should be applied by a camel's-hair pencil or with a soft cloth upon the finger or a stick. It should be so freely used in extensive and severe forms of the disease that the infant will swallow some, since the entire œsophagus is often also the seat of sprue in such cases. In the intervals between the applications of borax, if the buccal surface be hot, dry, and tender, so as t [illegible] fulness of the infant, it is well to use mucilaginou [illegible] cia or mallows. If the disease continue notwithstanding the use of these measures, the mouth should be occasionally washed with a weak solution of nitrate of silver or sulphate of zinc:

℞. Zinci sulph., gr. ij–iv;
Aq. rosæ, ℥ij. Misce.

In many cases, however, the treatment of thrush is of less importance than that of the disease which the thrush complicates. The remedial measures which I have mentioned then become subordinate to those employed for the graver disease. When this disease is relieved and the general health improves, thrush is more easily and permanently cured than during the state of feebleness and ill-health.

CHAPTER IV.

HÆMATEMESIS AND MELÆNA NEONATORUM.

HEMORRHAGE from the gastro-intestinal surface occurs in children from various causes. It is a common symptom of intussusception in infants. It occurs from dysentery and purpura and from the syphilitic dyscrasia. It has been observed in polypus of the rectum and in anal fissures. In rare instances it occurs from the irritation of lumbrici, from foreign substances which have been swallowed, and from the ulceration of typhoid fever. Intestinal hemorrhage from such causes is a symptom of constitutional or local disease. But in newly-born infants it sometimes occurs without other symptoms or without other appreciable disease, and therefore is regarded as an essential malady.

Melæna neonatorum was mentioned by Storck in 1750, and various writers at different times alluded to it or briefly described it prior to 1825. In 1825 it was more fully treated of by Hesse than by any of his predecessors.[1] The monograph published by him was valuable, as it contained his own observations and those of contemporary physicians communicated to him, as well as the investigations of his predecessors. Dr. Rahn-Escher of Zurich (1835), Meisner (1838), Kiwisch (1841), Rumpe (1841), Hoffman (1842), and Helmbrecht (1843) published memoirs or related cases of melæna. Several of the best-known authors on diseases of children, long recognized as authorities in this branch of practice, have also written on intestinal hemorrhage, as Billard, Vogel, Rilliet and Barthez, Barrier, Bouchut, West, Eustace Smith, and Goodhart, so that the literature of this disease is no longer meagre.

AGE.—In the statistics of Billard, embracing 15 cases, 8 were between the ages of one and six days, 4 between the ages of six and eight days, and 3 between the ages of ten and eighteen days. Of 20 cases embraced in the memoir of Rilliet and Barthez, 9 were at or under the age of thirty-six hours when the hemorrhage began, 5 between the ages of two and four days, 2 between six and eleven days, and 2 at the ages of fifteen and twenty weeks. Of 50 cases collated by Croom[2] from various sources, gastro-intestinal hemorrhage took place in 30 between the first and sixth days, in 8 between the sixth and eighth days, in 4 between the eighth and twelfth days, and in 8 between the twelfth and eighteenth days. The bleeding began in

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[1] *Annalen von Pierer*, 1825, Heft 6.

[2] *Medical Times and Gaz.*, Oct., 1880.

6 within the first twenty-four hours. These statistics, which correspond with those of other observers, show that in a large majority of cases the hemorrhage occurs within the first twenty-four hours. Hæmatemesis also takes place along with the intestinal hemorrhage in a considerable proportion of cases.

Etiology.—The cause of melæna of the newly-born is involved in some obscurity. To a considerable extent the causes are the same as in hemorrhage from the umbilicus, which we have treated of in a foregoing page. A predisposition to this and other forms of hemorrhage is sometimes inherited. Dr. Rahn-Escher states that the mothers sometimes have digestive ailments or other forms of ill-health, which he thinks produce atony of the vessels in the infants. The infant sometimes belongs to a family of bleeders and inherits hæmophilia. In the *Medical Times and Gazette* for October, 1880, Dr. Croom relates 4 cases in which there appeared to be an hereditary tendency to bleeding. In 1 of the cases the father was subject to hemorrhages; in another the pressure of the forceps produced extensive ecchymoses on both sides of the head. We have stated in our remarks on umbilical hemorrhage that newly-born infants affected by syphilis are very liable to intestinal and other forms of hemorrhage from the dyscrasia present or from anatomical changes in the walls of the minute vessels, or, as is probable, from both causes. Our article on umbilical hemorrhage contains the statistics of Mracek, who at the autopsies of 160 syphilitic infants observed internal hemorrhages in 42, but in only 4 of these was extravasated blood present in the intestines.

But the majority of the neonati who have gastro-intestinal hemorrhage do not appear to have any inherited dyscrasia or taint of system. Certainly the instances are exceptional in which the infants belong to families of "bleeders" or have the syphilitic dyscrasia. We must look for other causes apart from these. Billard attributes melæna of the newly-born to congestion of the vessels. Says he: "I have examined 15 cases of passive intestinal hemorrhage. . . . . Most of them were remarkable for the plethoric condition of their bodies and the general congestion of their integuments. . . . . In all the large abdominal vessels, the liver, spleen, lungs, and heart were considerably engorged with blood." He adds: "It cannot be too strongly recommended to accoucheurs to allow the umbilical cord to bleed when a child is observed to be in a state of asphyxia; for it has already been seen what serious effects follow from a superabundance of blood in young infants."[1] Vogel says: "The turgescence of the mesenteric arteries and their systems of capillaries, seen even in the physiological state, and produced by the sudden closure of the umbilical arteries, so important in the fœtus, and which arise directly from the hypogastric arteries, may be looked upon as a cause of this disease. An especial thinness of the walls or friability of the affected system of vessels must certainly play a part here, because otherwise this, in reality, very rare form of hemorrhage would have to occur much more frequently. The closure of the ductus venosus Arantii, and especially that of the branch of the umbilical vein opening into the portal vein, deserves more frequent and stricter investigation to explain this hemorrhage."

Rilliet and Barthez attach but little importance to the causes of melæna assigned by writers who preceded them, but state that it is easy to conceive that hyperæmia of the intestinal tube, which is normal in the newly-born, might be increased by atony of the vessels or impeded abdominal circulation, through arrest of the circulation in the portal vein, so that hemorrhage would be likely to occur. Incomplete establishment of respiration, in which congestion of organs occurs, and especially of the intestines, they regard as a predisposing cause. They admit hereditary influence in certain cases, as when a parent has been subject to hemorrhage. M. Bouchut[1] makes three groups of cases of melæna, according to the supposed etiology, as follows: First, melæna from purpura; second, from passive congestion, the result of compression at birth; third, from acute or chronic inflammation of the gastro-intestinal surface. Dr. West believes that tedious and difficult labor, in which the head of the child is compressed and abdomen injured, is an occasional cause of intestinal hemorrhage. The tardy and difficult establishment of respiration he also thinks may be a predisposing cause, but he adds, "Very often no reason can be assigned for it." In two post-mortem examinations which he made no adequate cause was discovered. Braun[2] mentions among the probable causes congestion of mesenteric vessels, pressure during birth, heredity, intra-uterine malnutrition. Steiner[3] believes that intestinal hemorrhage occurs sometimes from a round perforating ulcer due to fatty degeneration of the arteries. Hecker, Buhl, Spiegelberg, and Leopold Landau relate cases, six in all, in which abscesses or ulcers were observed in the stomach or duodenum, or in both. Landau expresses the opinion that these lesions occurring in the gastro-duodenal surface are produced by small embolisms. Reinhold[4] relates the case of an infant born May 15th who had hæmatemesis and melæna on the first day, and died May 17th. There was apparently epigastric tenderness. All the organs were anæmic, and the stomach contained seven or eight ulcers with edges slightly raised. No emboli could be discovered, but the umbilical vein contained a brownish-red clot.

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[1] *Treatise on the Diseases of Infants.*

On the other hand, J. Halliday Croom, lecturer on midwifery and diseases of women at the School of Medicine, Edinburgh, made the autopsy of a child that died of melæna at the age of half a day. The gastro-intestinal surface was carefully examined, and no abscess, ulcer, or erosion was discovered, but some congestion was observed in the lower part of the intestine. He alludes to another case, described by Helmbrecht, in which the only apparent morbid condition was congestion of the rectum. In another case, observed by Dr. Croom, an infant of three weeks, previously well, died of hæmatemesis and melæna. Both auricles contained firm clots, and in the aorta was a clot partly decolorized. The only abnormal appearance in the digestive tract was capillary injection of the duodenal surface.[5]

Epstein of Prague[6] in an interesting monograph on melæna neonatorum states that hemorrhage occurs in the newly-born from various causes—from disturbance of the circulation leading to congestion, from disease of the vessels, and from disease of the blood itself. In infants born partly asphyxiated after tedious labor, or in weakly infants with atelectasis, Epstein says that hyperæmia, hemorrhagic erosions, ulcerations, and actual hemorrhage of the gastro-intestinal surface are likely to occur. He believes that the most common cause of melæna is temporary congestion of the finer capillary vessels. When the surface of the stomach has been sprinkled with ecchymoses, small gastric ulcers have been present, caused by emboli in the gastro-duodenal vessels, resulting from thrombi in the umbilical vein.

From the above quite numerous observations we are able to affirm that hemorrhage from the stomach and intestines in the newly-born occurs from different causes, prominent among which are—1st, hæmophilia; 2d, inherited syphilis; 3d, congestion of the gastro-intestinal surface; 4th, ulcers occurring especially in the stomach, whether produced by emboli resulting from thrombosis in the umbilical vein or from other causes.

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[1] *Traité pratique des Maladies des Nouveaux-nés.*

[2] *Compendium des Kinderheilkunde*, Vienna, 1871.

[3] *Diseases of Children.*

[4] *Deutsche med. Woch.* No. 28, 1881.

[5] *Med. Times and Gaz.*, Oct., 1880.

[6] *Allgem. Wien. Med. Zeit.*, No. 49, 1882.

Diagnosis; Prognosis.—If the infant vomit blood, the nipple of the mother or wet-nurse should be inspected, for a considerable amount of blood is sometimes drawn by suction from the nipple. If no abrasion or sore be discovered upon or around the nipple or upon the lips or in the mouth of the infant, we may assume that hemorrhage is occurring from the stomach or upper part of the intestines of the infant. The presence of blood upon the diaper without any fissure upon the anus or external source of its occurrence is evidence of intestinal hemorrhage. The blood is dark and more or less changed by digestion or the action of the intestinal secretions if it have lain some time in the intestines. The pallor of the infant and increasing feebleness are evidence of the loss of blood. But in one instance myself and two other physicians were deceived by a midwife who had loosely ligated the umbilical cord, so that fatal hemorrhage occurred from it. The case was reported as one of intestinal hemorrhage, and was recorded as such in the statistics of the Health Board. The source of the hemorrhage was ascertained by a post-mortem examination which we were fortunate in obtaining. The gastro-intestinal surface was normal except its extreme bloodlessness and pallor.

The prognosis is in most instances unfavorable, but if the infant be strong and the amount of hemorrhage small, we may hold out some encouragement of a favorable result. It is possible, indeed, that a considerable amount of blood be lost and the infant recover. But weakly infants who have an abundant hemorrhage sink rapidly. If the bleeding do not cease in twenty-four hours, death will probably be the result.

Treatment.—The child should be nourished at the breast if possible, and a little ice-water be given with a spoon along with the breast-milk. If the infant do not have breast-milk, peptonized milk may be employed. The food, of whatever kind, should be given cool. It has been recommended to apply the ice-bag over the abdomen while warm applications are made to the extremities. One grain of tannic or gallic acid dissolved in cool water may be given every hour, or one or two drops of turpentine. If the child exhibit signs of failing strength, a few drops of brandy should be given at short intervals in cold peptonized milk.

Diarrhœa of the Newly-born.

The colostrum, or the first secretion of the mammary glands after parturition, contains more oily matter and sugar than occur in the subsequent secretion. In consequence of this peculiarity in its composition the colostrum has a laxative effect by which the meconium is expelled. If the mammary glands continue to secrete colostrum after the first week, diarrhœa is likely to result. A more common cause of diarrhœa of the newly-born is the employment of various sweetened mixtures by mothers or nurses in the belief that the breast-milk is inadequate, or they are employed for the purpose of relieving the supposed colicky pains whenever the baby frets. Cane-sugar added to the various mint teas not only gives rise to diarrhœa, but also in time to more or less gastro-intestinal catarrh and stomatitis, with the occurrence of sprue. Sprue is more common in the newly-born than at any other period of life, and it can usually, according to my experience, be traced to the use of improper sweetened mixtures. The infant immediately after birth may be given a little sweetened water or a teaspoonful of sweet oil to aid in the expulsion of the meconium, but subsequently, in the great majority of cases, no carminative or nutritive mixtures are required. The breasts of the mother if she have the usual health furnish all that is needed. The neonatus requires almost no nutriment during the first three days, and the breasts furnish but little during this time, but frequent traction upon the nipple promotes the mammary secretion, and after the third day, in ordinary cases, sufficient nutriment is obtained from the breasts to supply the wants of the system and promote a healthy growth. If what is natural were left to itself, and no artificial measures were employed, the result in most instances would be good; but the unfortunate practice of filling the infant's stomach with various admixtures disturbs normal digestion, impairs the appetite, causes colicky pains, vomiting, and diarrhœa, and, if persisted in, gastro-intestinal catarrh. In many cases green fermenting and unhealthy stools cease, and a more normal state of the digestive apparatus is produced by forbidding the use of superfluous and injurious food and drinks which had been given to supplement wet-nursing in the mistaken belief that more food was required. Food in excess, even if it be of the proper quality, even if it be breast-milk, usually causes diarrhœa if it be not vomited, since, not being digested, it undergoes fermentative changes, and acts as an irritant until it is expelled. Food containing a large proportion of sugar is laxative in consequence of the sugar.

Diarrhœa in the newly-born, whatever its cause, should be immediately arrested. After the meconium is removed by the action of the colostrum, three daily evacuations from the bowels are sufficient. A larger number is usually attended with loss of flesh and strength. The use of sweetened mixtures, which nurses are in the habit of administering when infants are not well, as catnip, fennel, or aniseed tea, we repeat, must be strictly forbidden. A mother with a sick and fretful infant usually applies it to the breast too frequently, even every half hour during the day. This should also be strictly forbidden. The infant, like the adult, should take food at stated intervals, so that the digestive organs may have some respite from the task of digestion. The application of the new-born infant to the breast twelve times in twenty-four hours is sufficient for its nutrition, and the mother's health is better preserved and her milk of better quality than when she is deprived of the needed rest by more frequent suckling. If the infant be unfortunately deprived of breast-milk and be bottle-fed, the utmost care is required in the selection and preparation of the food, as well as in determining the amount of food to be given and the frequency of feeding. Facts relating to this important subject have been presented in preceding pages. Young bottle-fed infants with too frequent and unhealthy stools sometimes do well with peptonized milk, especially if flour prepared by long boiling be added to it. The important advantage possessed by this flour is that its starch is converted into the soluble form, and a considerable part of it into dextrin, so that it can apparently be digested by young infants more readily than ordinary flour. A teaspoonful of the flour long boiled may be added to twenty teaspoonfuls of peptonized milk for young infants with diarrhœa. The beneficial effect of the flour is due largely to its mechanical action in separating the particles of casein, so that they can be acted on more readily by the gastric juice, which in young infants is secreted in small quantity. Sometimes in treating the diarrhœa of young infants, if it be severe, it is better to withhold entirely milk in any form a few days, and give in its place a light gruel prepared by adding the barley or wheat flour, long boiled, to water in the proportion of one part to twenty. When it is heated to the boiling-point to destroy any microbes in the water, place it upon ice or in cool water, and when its temperature is reduced below blood-heat the white of an egg or half an egg may be added with sufficient salt. This farinaceous diet sometimes aids materially in checking the diarrhœa. Dextrin can be digested by the youngest infant, and the little patient may be sufficiently nourished for a week or more by the wheat or barley flour prepared in the manner stated in the chapter on infant feeding, with the salt and perhaps white of egg added.

If the diarrhœa do not cease by the use of the proper diet given in suitable quantity at proper intervals, which should not be oftener than two and a half to three hours, medicinal treatment is needed. I have found the following prescriptions very useful for the diarrhœa of infants under the age of one month, as well as for those that are older:

℞. Bismuthi subnitrat., ʒiij;
Pepsini puri in lamellis, ʒj. Misce.

Give as much as goes on a ten-cent piece before each feeding.

℞. Bismuthi subnitrat., ʒij;
Misturæ cretæ, ℥ij. Misce.

Shake bottle, and give twenty drops midway between the feedings to a child of two weeks. This alkaline mixture neutralizes the lactic, butyric, or other injurious acid which may exist in excess in the stomach or intestines. In some instances one or two drops of paregoric, given three or four times daily, have a salutary effect by diminishing the peristalsis.

CONSTIPATION OF THE NEWLY-BORN.

In the infant constipation results from several different causes. The most serious and obstinate form of it, to which the term obstipation is more appropriately applied, arises from intestinal malformations. In rare instances congenital obstruction occurs in the small intestines. It is sometimes produced by cystic tumors or twisting of the intestine. Congenital stenosis occasionally occurs at the ileo-cæcal orifice. Thus, in the *Transactions of the London Pathological Society* for 1870 is the history of a case in which there was such narrowing of the ileo-cæcal orifice, believed to be congenital, that a No. 9 catheter could barely be passed through it. The patient lived until his thirty-second year, but throughout his life suffered from constipation and colic. After his death the ileum next to the ileo-cæcal valve was found to have a diameter of seven inches, while the large intestine was much atrophied and its entire lumen contracted from disuse. Occasionally the stenosis occurs a little above the ileo-cæcal orifice, and rarely in the duodenum at the point of union of the pancreatic or bile-duct with the intestine. The obstacle in some instances appears to be hypertrophied valvulæ conniventes, the edges of two opposite folds being more or less adherent. Such congenital intestinal obstructions—whether, as is probable, produced by inflammations in the fœtus or from simple perverted nutrition; whether arising from the syphilitic cachexia or other cause—of course retard the evacuations according to their location and the amount of closure. The same degree of stenosis in the colon or rectum obviously causes a more constipating effect than in the small intestines, since the latter have more mobility than the former and their contents are more liquid.

But the most common of the congenital obstructions in the intestines occur from malformations of the rectum. These malformations vary considerably in different cases. They may be classified in at least four different groups: 1st. The anus may appear normal, but instead of the normal rectum two cul-de-sacs are present, representing the upper and lower ends of the rectum, and connected by an occluded segment of the rectum or by a firm fibrous cord. 2d. The anus is absent, and the rectum has a fistulous opening in the perineum, or through the scrotum in the male or vulva in the female. In the embryonic development the outlet of the rectum was formed too near and encroached upon the sexual apparatus. 3d. The anus is absent, and there is no external fistulous opening representing the anus, but the rectum opens at some point upon the mucous membrane of the genito-urinary apparatus. 4th. Anus absent and the entire lower part of the rectum obliterated. The upper portion of the rectum terminates in a cul-de-sac in the neighborhood of the promontory. Some of these malformations do not prevent the discharge of fecal matter, but when there is closure of the rectum and no fistulous opening, of course no evacuation of the intestines can occur unless relief be obtained by surgical measures. In the ordinary form of occlusion a portion of the rectum is represented by a cord, or a firm, unyielding septum shuts off the lower part of the rectum from that above, so that defecation is impossible. The infant with this serious malformation takes the breast for a time like other infants, but the intestines soon become distended with fecal matter, and restlessness from the distension and vomiting occur. The only mode of relief is by an incision or puncture through the obstruction; but a large proportion of infants with this obstructive malformation die whether operated on or not. The incision or puncture should be made as soon as the obstruction is discovered, and if successful in reaching the distended intestine above the malformation, the passage thus made should be kept open by tubing of the proper size if the infant live. If the operation be unsuccessful in releasing the imprisoned fecal matter, an artificial anus may be made on the left or right side.

The great length of the sigmoid flexure in infancy, and the curvatures which occur in consequence, more in number than in older children, tend to retard the descent of fecal matter and promote constipation. In the adult numerous depressions and inequalities in the colon retard the downward movement of the intestinal contents, but in infancy the surface of the colon is comparatively smooth and even, and the detention, so far as any exists, occurs from the curvatures or loops, which are sometimes twisted partially on their axes. The sigmoid flexure is so long in infants under the age of ten, and especially of six months, that the curvatures usually lie in part to the right of the median line, and even in the right iliac fossa. Those who have witnessed the post-mortem examinations of young infants in the asylums find no difficulty in accepting the statement of certain writers that the curvatures or loops in the sigmoid flexure, which sometimes extend as high as the umbilicus, and laterally to the right iliac fossa, cause habitual constipation in some infants.

Occasionally in young infants, as well as in those who are older, the intestines act sluggishly from insufficiency of food. Thus the infant sometimes hangs an unusually long time on the breast, and the mother or wet-nurse believes it to be a hearty nurser, when there is really a deficiency of milk, and the stools are scanty and infrequent from lack of material: under such circumstances the infant is restless when away from the breast, or, not being fed, loses flesh, and soon has the appearance of one in ill-health. These symptoms disappear by a more liberal allowance of food of proper quality. Thus, recently a young infant was brought to me suffering from constipation and fretfulness, with progressive loss of flesh and strength and with abundant urination. Its only food, prepared through the advice of a physician, consisted of a teaspoonful of condensed milk to one pint of water. By a more liberal supply of food the constipation disappeared.

Again, a constipated state of the bowels occasionally occurs in infants who nurse heartily and seem to obtain a sufficient quantity of milk; and the cause of it appears to be in the state of the digestive organs, and not in the milk. We find now and then that breast-milk has a constipating effect, although we discover nothing in the mother's diet or health to cause this result. The comparison of ordinary breast-milk with colostrum may furnish an explanation of the constipation under such circumstances. Colostrum is known to be more laxative than ordinary milk, and it differs from it chemically in containing more butter, sugar, and salts. Hence the theory seems plausible that when breast-milk is constipating these elements occur in less than the normal quantity, and we will find that treatment suggested by this theory tends to obviate the constipation.

Constipation has also been attributed to a deficiency in the intestinal secretions and to too great viscidity of them from lack of water. Deficient peristalsis, whether from congenital weakness or other cause, also leads to constipation. The use of starchy foods without sugar or with but little sugar also sometimes has a constipating effect.

Gautier of Geneva, Switzerland, states that an anal fissure is a common cause of constipation, whether in the newly-born or older infants. If such a fissure be present, pain in defecation might instinctively lead the infant to resist the desire to evacuate the bowels and to postpone the act, so as to establish a constipated habit; but if such fissures are common in this country, except in the syphilitic, they have escaped our notice.

Finally, constipation has a tendency to perpetuate itself, since retained feculent matter becomes more consistent and firmer, and the contractile power of the muscular tissue becomes weakened by over-distension.

SYMPTOMS.—When there is a mechanical cause of scanty and infrequent defecation, the acuteness of the symptoms and the suffering are usually proportionate to the degree of obstruction. In cases of complete obstruction of the intestines, as in imperforate rectum, fecal accumulation occurs above the obstruction. Under such circumstances distension of the abdomen, vomiting, fretfulness apparently from the abdominal pain, and progressive loss of flesh and strength, indicate the serious nature of the disease.

In constipation from other causes—that is, without obstruction except such as arises from fecal accumulation—the condition of the infant may attract little attention at first; but if it do not have proper evacuations it soon begins to suffer in its health. Fretfulness, an unhealthy physiognomy, vomiting, and more or less fever occur, until the patient is relieved of the ailment.

A beautiful and conservative provision in the system is that by which vicarious functions are established to relieve organs which imperfectly perform their part. While the intestinal surface is to a great degree eliminative, so that noxious and effete products are expelled from the system in the stools, it possesses also in a high degree an absorbent function, as all who employ rectal alimentation are aware. If the intestine fail to perform its function of defecation, so that feculent matter collects within it and begins to exert pressure on the intestinal surface, more or less of the liquid portion is taken up by the absorbents, and, entering the general circulation, it finds a mode of escape through other emunctories. The general ill-health or languor, the furred tongue, foul breath, and pain in the head which characterize these cases are no doubt due to the absorption into the blood of noxious products derived from retained feculent matter. But cases to which this description is applicable are not common in early infancy. In the infant the retention is often only in the rectum or rectum and sigmoid flexure, and the symptoms are mild and are relieved by free evacuations, which are easily obtained. Between these mild cases and the graver forms of constipation, such as result from mechanical obstructions, there is every intermediate grade, attended by symptoms proportionately severe.

TREATMENT.—It is very important that constipation in the infant should be detected and promptly treated. Not only its present health, but future well-being, requires this, for the longer the constipated habit continues the more difficult is the cure; and an examination of the records of extreme constipation in adult life which are found in medical literature reveals the fact that in many instances the sluggish state of the intestines commenced in early infancy. The following case, observed by Renauldin and related by Dr. Copland in his *Medical Dictionary*, may be given as an example: A medical officer in the French service had been constipated from birth. He ate like others, but habitually had only one stool in a month or two months, and at the age of forty-two three to four months elapsed between the evacuations. His abdomen was greatly distended and painful, and he seldom passed more than four to six stools in the year; but he lived until the age of fifty-four years. After his death the constipation was found to be due to a fibrous but incomplete septum only one inch above the anus, the result, apparently, of a malformation in the fœtal development. Even when no malformation is present constipation in adult life can frequently be traced back to infancy.

Usually it is best to commence the treatment of constipation by an enema, which softens and removes the hardened masses which have collected in the rectum and the adjacent part of the large intestine. For a young infant tepid water or tepid water containing a teaspoonful of glycerin suffices to produce an evacuation. No possible harm can result from rectal injections when properly employed; and as they commonly act promptly, without causing pain and without any depressing effect, they constitute an important part of the treatment in all forms of constipation. I have sometimes, in cases of habitual constipation, ordered for young infants the daily injection of three teaspoonfuls of sweet oil and one of castor oil. Injections should always be prescribed instead of medicine by the mouth when there is reason to believe that the cause of the constipation is mechanical, as from the great length and many loops in the sigmoid flexure. There are cases of constipation from this cause for which injections should be employed daily for many months, and if given gently, with a properly lubricated instrument, they ultimately give complete relief, and without producing any injurious effect. One of the meat broths or a gruel of some farinaceous substance may sometimes be advantageously employed for the same purpose.

In the common forms of constipation, in which the cause is feeble peristalsis or scanty intestinal secretions or the use of food of too constipating a nature, we should endeavor to render the ingesta more laxative. Professor Jacobi has recommended for this condition to give a lump of sugar dissolved in water at each nursing. I have employed the sugar of milk, given in half-teaspoonful doses, to young infants also at each nursing, or several times through the day if required. Manna dissolved in hot water is also an old remedy for the same purpose. Glucose, into which starch is converted in the process of digestion and also by the action of the diastase of malt, is likewise laxative. The various foods of the shops which contain glucose derived from barley or other flour by the agency of malt, employed as directed by the late Baron Liebig, are therefore useful in the treatment of habitual constipation in infants. Of four constipated infants in the New York Infant Asylum to whom Horlick's "sugar of malt" was given, three were relieved. Any of the glucose preparations can be given quite freely to a constipated infant without impairing the digestive function or producing other ill-effect, so long as no more than the normal evacuations are produced; and I consider them among the best and safest of the foods for the relief of constipation in infants. But glucose or grape-sugar is only feebly laxative; probably not more so than cane-sugar.

The ordinary purgatives should not be given habitually to relieve a constipated habit. They are likely to irritate the intestines, causing a catarrh, or else, the intestines becoming accustomed to their action, a large dose is required. If possible, the bowels should be kept open by dietetic and hygienic measures. A light oatmeal gruel, long boiled, mixed with salt and considerable sugar, given at or between the nursings, sometimes has the desired effect, especially if in addition to the salt it contain considerable sugar. We may aid in increasing the peristalsis and overcoming the constipation by the massage treatment over the bowels. The fingers, lubricated with any kind of oil, should rub and knead the abdominal surface. I have seen the best results from this treatment. Cold applications over the abdomen, so highly recommended by Trousseau in adult cases, cannot be safely employed in infancy, especially in early infancy. A well-known remedy in adult cases is the use morning and evening of a tumblerful of cold water. Water may also be added in considerable quantity to the ingesta of the constipated infant.

Although, as stated above, we deprecate the necessity of using habitually purgative medicines for constipation, sometimes they are required, but if a laxative remedy which aids in the nutrition be prescribed, there is no objection to its use. Such a remedy is the following:

℞. Ol. morrrhuæ, ℥iv;
Aq. calcis,
Syr. calcis lactophos., *āā*. ℥ij.

Shake bottle and give half a teaspoonful three times daily to young infants But this remedy, useful in some cases, in others disappoints our expectations. If it be necessary to employ one of the recognized purgatives, the safest and best in my opinion is calcined magnesia, given in the following formula:

℞. Magnesia calcinat., ℥j;
Sacchari lactis, ℥ij. Misce.

Fifteen grains to a drachm, according to the age, may be given to infants, and repeated as may be found necessary.

The newly-born infant when in health ordinarily has about three stools daily, but one free evacuation may be sufficient. We know that the function of defecation is, to a certain extent, under the control of habit. Adults who have evacuations at a certain hour feel the need of them each day as that hour arrives. We should endeavor to encourage this habit in infancy and childhood.

CHAPTER V.

TETANUS NEONATORUM.

TETANUS or trismus is one of the most interesting diseases of infancy. It is one of the first in point of time in the long catalogue of fatal maladies. It occurs suddenly and unexpectedly in the robust as well as the feeble, almost certainly destroying life within a few hours under modes of treatment heretofore employed. It is more frequent in some localities and conditions of life than in others. In New York it is more common in infancy than tetanus at any other age, or, indeed, in all other ages, since the mortuary statistics of this city exhibit a larger number of deaths from this disease in the first year of life than subsequently. Infantile tetanus occurs, with very few exceptions, in the newly-born.

Did we fully understand the pathology of diseases in the new-born, or could we more accurately ascertain the condition of organs at this age, doubtless we should occasionally consider those phenomena which we now designate as a disease *per se*, under the title tetanus, as symptoms of some other affection. But as tetanic rigidity and spasms in the new-born occur so abruptly, masking all other symptoms and ordinarily ending in death, without our knowing certainly whether or not there is any antecedent disease, it seems proper that we should recognize the state in which such muscular rigidity occurs with such a rapid result as an independent affection. This explanation is required from the fact that I have added to the accompanying table one case from Billard which this observer relates under the head of spinal meningitis. In this case an infant three days old was attacked with convulsions. "His limbs were rigid and violently bent; the muscles of the face were in a continual state of contraction." On the following day "the convulsions continued; . . . . the body remained rigid, and the vertebral column, which the weight of the trunk will cause to bend with the greatest ease in a young infant, remained straight and immovable whenever the child was raised." At the autopsy, in addition to meningeal apoplexy, which is often present in those who die of tetanus infantum, a thick pellicular exudation was found upon the spinal arachnoid. There is, therefore, a strict accordance of the symptoms and history of this case with those which other observers describe as examples of tetanus infantum; moreover, as a satisfactory reason for including this case in our statistics, certain observers, as we shall see, have reported epidemics of tetanus in which meningitis was the principal lesion.

FATAL CASES.

Case 1. Male; taken when three days old; lived sixty hours. Labatt, *Edin. Med. and Surg. Jour.*, April, 1819.
" 2. Female; taken when three days old; lived forty hours. *Ibid.*
" 3. Taken when five days old; lived fifty hours. *Ibid.*
" 4. Taken when three days old; lived one day. *Ibid.*
" 5. Male; taken when two days old; lived two days. Billard, *Treatise on Diseases of Children*, Stewart's trans., p. 477.
" 6. Male; taken when three days old; lived two days. Romberg.
" 7. Male; taken when six days old; lived ninety-three hours. Dr. Imlach, *Month. Jour. of Med. Sci.*, Aug. 1850.
" 8. Female; taken at five days; lived four days. Caleb Woodworth, M. D., *Boston Med. and Surg. Jour.*, Dec. 13, 1831.
" 9. Negro; taken at seven days; lived twenty-four hours. P. C. Gaillard, M. D., *South. Jour. of Med. and Phar.*, Sept. 1846.
" 10. Male; taken when seven days old; lived one day. Augustus Eberle, M. D., *Missouri Med. and Surg. Jour.*, 1847.
" 11. Taken when seven days old. D. B. Nailer, *N. O. Med. Jour.*, Nov. 1846.
" 12. Male; taken when three days old; lived one day. *N. O. Med. and Surg. Jour.*, May, 1853.
" 13. Negro; taken when three days old; lived three days. Robert H. Chinn, M. D., *N. O. Med. and Surg. Jour.*
" 14. Taken when two days old; died in four hours after the doctor's visit. *Ibid.*
" 15. Taken when seven days old; lived one day. C. H. Cleveland, *New Jersey Med. Rep.*, April, 1852.
" 16. Negro; taken when seven days old; death finally. Greenville Dowell, *Amer. Jour. of Med. Sci.*, Jan. 1863.
" 17. Taken when twelve days old; lived one day. Thomas C. Boswell, communicated to Dr. Sims, *Amer. Jour. of Med. Sci.*, 1846.

Case 18. Taken when about five days old; died at about the age of nine days. B. R. Jones. *Ibid.*
" 19. Taken at or soon after birth; lived two days. Dr. Sims, *Amer. Jour. of Med. Sci.*, April, 1846.
" 20. Taken at the age of six days; lived one day. *Ibid.*
" 21. Taken when three days old; lived two days. *Ibid.*
" 22. Male; taken at the age of eight days; died in three hours. Communicated to the writer.
" 23. Taken at the age of twelve hours; lived two days. Communicated to the writer.
" 24. Female; taken when seven days old; lived forty-five hours. The writer.
" 25. Male; taken at the age of seven days; lived forty-eight hours. *Ibid.*
" 26. Female; taken at the age of eight days; lived three days. *Ibid.*
" 27. Female; taken at the age of five days; lived three days. *Ibid.*
" 28. Female; taken when four days old; lived two days. *Ibid.*
" 29. Taken when six days old; died next day. *Ibid.*
" 30. Taken when five days old; lived twenty-four hours. *Ibid.*
" 31. Taken when eight days old; lived two days. *Ibid.*
" 32. Male; taken when five days old; lived one day. *Ibid.*

FAVORABLE CASES.

Case 1. Negro; female; taken when three days old; recovered in a few days. Robert S. Baily, *Charleston Med. Jour. and Rev.*, Nov. 1848.
" 2. Negro; taken at eleven days; recovered in fifteen days. W. B. Lindsay, *N. O. Med. Jour.*, Sept. 1846.
" 3. Negro; taken when ten days old; recovered in thirty-one days. P. C. Gaillard, *Charleston Med. Jour. and Rev.*, Nov. 1853.
" 4. Male; taken at the age of eight days; recovered in twenty-eight days. *Ibid.*
" 5. Negro; taken at seven days; recovered in fifteen days. Augustus Eberle, *Missouri Med. and Surg. Jour.*, 1847.
" 6. Taken when eight days old; recovered in four weeks. Furlonge, *Edin. Med. and Surg. Jour.*, Jan. 1830.
" 7. Taken at the age of one week; recovered in two days. Dr. Sims, *Amer. Jour of Med. Sci.*, April, 1846.
" 8. Female; taken at the age of three days; recovered in five weeks. The writer.

PERIOD OF COMMENCEMENT.—Finckh,[1] who saw cases of tetanus of the newly-born in the Stuttgart Hospital, states that it began in 1 case on the second day after birth, in 8 on the fifth, and in 7 on the seventh.

Professor Cederschjold of Stockholm treated 45 cases in hospital practice in 1834, and in these cases it usually commenced between the ages of four and six days. Copland[2] says that it generally commences in the first seven or nine days after birth, and rarely later than the fourteenth. Romberg states that it commences between the fifth and ninth days. In 200 cases observed by Reicke in Stuttgart in the course of forty-two years, it was never found to commence before the fifth, rarely after the ninth, and never after the eleventh day. Schneider says that the disease occurs oftenest between the second and seventh, and rarely after the ninth, day. In 6 cases reported by Dr. C. Levy of Copenhagen it began in 2 on the third day, in 2 on the fifth, and in 2 on the sixth. Dr. Greenville Dowell,[3] who has seen much of tetanus neonatorum among the negroes in Mississippi and Texas, says it is almost sure to come on between the fifth and twelfth days after birth. In the 40 cases embraced in the above table the disease began as follows:

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[1] *Hecker's Annalen*, vol. iii. No. 3, p. 304.
[2] *Medical Dictionary.*
[3] *Amer. Jour. of Med. Sci.*, Jan., 1863.

Age.	Cases.
Under two days	2
Two days	1
Three days	9
Four days	2
Five days	6
Six days	3
Seven days	8
Eight days	6
Ten days	1
Eleven days	1
Twelve days	1

Very rarely, as will be seen hereafter, tetanus begins at or so soon after birth that it may properly be called congenital.

FREQUENCY IN CERTAIN LOCALITIES.—Tetanus neonatorum occurs probably in all countries, but it does not greatly increase the mortality except in certain localities. Some of the British and Continental physicians, whose observations of disease have been ample, confess that they have seen so few cases that they have almost no personal knowledge of this malady. On the other hand, there are or have been places in every zone where it is or has been so prevalent as to sensibly check the increase of population. The attention of the profession more than a half century since was directed to the prevalence of tetanus in the island of Heimacy, off the coast of Iceland. On this island scarcely an infant escaped, while on the mainland scarcely one was affected. Heimacy, the product of volcanic action, of small extent and almost destitute of vegetation, supports a scanty population. The inhabitants live chiefly on the flesh and eggs of the sea-fowl, and are filthy and degraded in their habits. About the year 1810 the Danish government deputed the *landphysicus* of Iceland to visit Heimacy and ascertain the nature of the disease which was so destructive to the infants. Although this gentleman, from his brief stay, saw no case himself, he obtained interesting particulars in reference to the disease from the priests and parents. At this time scarcely an infant escaped. Again, according to Dr. Schleisner, whose report in reference to the same locality was published forty years later, tetanus was still the most fatal of all infantile maladies.

Tetanus neonatorum is also represented as very fatal in the island of St. Kilda, off the coast of Scotland. In the temperate regions of America and Europe cases are not frequent, except occasionally in the poor quarters of cities, in foundling hospitals, and rarely in country towns where the conditions are favorable for its occurrence. The records of the Dublin, Stuttgart, and Stockholm lying-in asylums furnish many cases. In the town of Fulda, Germany, in 1802, Dr. Schneider saw 6 cases in fourteen days, while a midwife in the same place stated that she had seen more than 60 in nine years.

But the greatest mortality from tetanus neonatorum is in the warm climates both of the Eastern and Western hemispheres. In the West Indies, the southern portion of the United States, the equatorial regions of South America, and in the islands of Minorca and Bourbon, it has in many localities been the most frequent and fatal of infantile maladies.

It is an interesting fact that in the warm regions of the United States the victims are chiefly negro infants. L. S. Grier, M. D.,[1] of Mississippi says: "The first form of disease which assails the negro among us is trismus. The mortality from this disease alone is very great. No statistical record, we suppose, has ever been attempted, but from our individual experience we are almost willing to affirm that it decimates the African race upon our plantations within the first week of independent existence. We have known more than one instance in which, of the births for one year, one-half became the victims of this disease, and that, too, in spite of the utmost watchfulness and care on the part of both planter and physician. Other places are more fortunate, but all suffer more or less; and the planter who escapes a year without having to record a case of trismus nascentium may congratulate himself on being more favored than his neighbors, and prepare himself for his own allotment, which is surely and speedily to arrive." Dr. Wooten[1] says: "It is a disease of fatal frequency on the cotton plantations in this section of Alabama." He has, however, never seen a white child affected with it.

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[1] *N. O. Med. and Surg. Jour.*, May, 1854.

While tetanus infantum prevails in regions wide apart and presenting very diverse climatic conditions, there is a similarity as regards the personal and domiciliary habits of the people who suffer most from its occurrence. It occurs chiefly among those who are filthy and degraded in their habits—who live, either from choice or necessity, in neglect of sanitary requirements. This fact aids us in an understanding of the

CAUSES.—That uncleanliness and impure air are causes of tetanus is as fully demonstrated as most facts in the etiology of diseases. The attention of the profession was forcibly directed to this cause by Dr. Joseph Clarke in a paper read before the Royal Irish Academy in 1789. This physician was in charge of the Dublin Lying-in Asylum, and had rightly concluded that the mortality among the new-born infants was due to imperfect ventilation. Through his advice, apertures (twenty-four inches by six) were made in the ceiling of each ward; three holes, an inch in diameter, were bored in each window-frame; the upper parts of the doors leading into the gallery were also perforated with sixteen one-inch apertures, and the number of beds was reduced. The results of these simple sanitary regulations may be seen from Dr. Clarke's own statement. He says: "At the conclusion of the year 1782, of 17,650 infants born alive in the Lying-in Hospital of this city, 2944 had died within the first fortnight—that is, nearly every sixth child." The disease in nineteen cases out of twenty was tetanus. After the wards were better ventilated—namely, from 1782 till the time of the preparation of Dr. Clarke's paper—8033 children were born in the hospital, and only 419 in all had died, or about one in nineteen. So impressed was Dr. Evory Kennedy, who at a later period had charge of the same asylum, with the belief that Dr. Clarke had discovered the true cause, and had been able in great measure to prevent it, that he enthusiastically writes: "If we except Dr. Jenner, I know of no physician who has so far benefited his species, making the actual calculation of human life saved the criterion of his improvements." The cases occurring in my own practice have almost all been in tenement-houses, where habits of cleanliness are not observed, and I have not yet seen in the practice of others nor heard of a case which occurred in the better class of domiciles. The statements of physicians in the Southern States, who speak from extensive observation among negroes, are strongly corroborative of the belief that the disease is in great measure due to uncleanliness and lack of pure air.

Dr. Greenville Dowell of Texas states that he has been able to trace tetanus infantum to the bed-clothes, saturated with excrementitious matters, which are found in the negro cabins. In a paper published by Prof. John M. Watson[2] the frequency of this disease among negroes is accounted for as follows: "When called to see their children we find their clothes wet around their hips, and often up to their armpits, with urine. . . . . The child is thus presented to us, when, on examination, we find the umbilical dressings not only wet with urine, but soiled, likewise, with feces, freely giving off an offensive urinous and fecal odor, combined at times with a gangrenous fetor arising from the decomposition, not desiccation, of the cord."

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[1] *N. O. Med. and Surg. Jour.*, May, 1846.
[2] *Nashville Jour. of Med. and Surg.*, June, 1851.

Another cause is believed to be some irritation in the intestines, as from retained meconium. Observers in the Southern States and elsewhere occasionally mention this as a cause. In one case treated by myself there was obstinate constipation immediately before the attack, and in another diarrhœa preceded and was the only apparent cause.

In certain cases the assignable cause is exposure to wet or cold or to a variable temperature, which, it is known, occasionally produces tetanus in the adult. Prof. Cederschjold attributed the epidemic which he observed in Stockholm to a sudden change of temperature from hot weather in May to frosty in June. In a case related by Dr. P. C. Gaillard[1] the disease commenced as follows: The nurse came in with wet apron and clothes in the evening; a short time after she had taken the child into her lap it sneezed violently two or three times. At 10 P. M. tetanus began. In certain localities on the Continent, where there are no parish churches, the frequent occurrence of tetanus has been attributed by physicians to the practice of carrying infants to a distance to be christened, thus exposing them to winds. In this city I have observed tetanus after a similar exposure. The influence of the weather in the production of tetanus of the new-born is also shown by facts observed in the Stuttgart hospital. In an aggregate of 25 cases treated in that institution, all but 3 occurred in the cold months. In the island of Cayenne, at a hamlet surrounded by mountains and dense forests, tetanus attacked only one in every twelve of the new-born infants. After a great part of the forests had been cut down, so as to allow access to the cold sea-winds, almost all the new-born infants fell victims to tetanus (*Insel. Cayenne*).

Hein relates that a citizen of Berlin lost, successively, two children with tetanus soon after birth. When the second child fell ill he observed that its cradle was exposed to a current of air. At the third accouchement the position of the cradle was changed and the infant escaped. Exposure to wet and cold has been long recognized as a cause of the disease. According to Sauvages, "Hic morbus hieme et cum aurâ humidâ sæpius advenit quam sicca æstate."[2]

The causes of infantile tetanus enumerated above may be proximate or remote, may produce the disease by their direct effect on the system or indirectly by causing a pathological state which in turn leads to the development of the disease. There are other direct causes—namely, organic affections. In the bodies of the new-born who die of tetanus lesions are observed which doubtless result from the spasms. Again, others are found which from their nature could not be a result, and which, being observed in different cases, are to be regarded as causes. The most frequent of such lesions is inflammation of the umbilicus or umbilical vessels.

Moschion, who lived in the first century of the Christian era, stated in writings still extant that stagnant blood in the umbilical vessels sometimes produced dangerous disease in the new-born infant, and it is supposed, though this is doubtful, that he referred to tetanus. In modern times the attention of the profession has been more particularly directed to this cause by a paper published by Dr. Colles.[3] The observations contained in this paper were made in the Dublin Lying-in Hospital during a period of five years. In each of these years he witnessed from three to five post-mortem examinations in cases of infantile tetanus, and the lesions, he states, were in all much alike, as follows: The floor of the umbilical fossa was lined by a membrane apparently formed by suppurative inflammation, and in the centre of this fossa was a large papilla. This papilla consisted of a soft yellow substance, apparently the product of inflammation, and in all the cases the umbilical vessels were in contact with this substance and were pervious. In a few instances superficial ulcerations were found near the mouth of the umbilical vein, and occasionally the skin surrounding the umbilicus was raised. The peritoneum covering the vein was highly vascular, often not to a greater distance that an inch above the umbilicus, but sometimes as far as the fissure of the liver. The peritoneum in the course of the umbilical arteries presented the inflammatory appearance in still greater degree, sometimes as far as the sides of the bladder. The connective tissue lying along the arteries and urachus anteriorly was loaded with a yellow watery fluid. The inner surface of the umbilical vein was not inflamed, but its coats in general were thickened. On slitting open the arteries a thick yellow fluid, resembling coagulable lymph, was found within their coats, and in all cases these vessels were thickened and hardened as far as the fundus of the bladder.

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[1] *Southern Jour. of Med. and Pharmacy*, Sept., 1846.

[2] *Nosol. Method.*, vol. i. p. 531.

[3] *Dublin Hospital Reports*, vol. i., 1818.

Dr. Finckh, who observed 25 cases in the Stuttgart Hospital, believes that the most frequent cause was suppuration or ulceration of the umbilical cord. In 10 of the 25 cases the navel was dry and cicatrized; in the remainder it was either wet or swollen, with a bluish-red inflamed edge at the margin of the navel; a dirty viscid pus covered the umbilical depression.

Dr. Levy, physician of the Foundling Hospital in Copenhagen, attended 22 cases in that institution in 1838 and 1839. Of these, 20 died, and 15 were examined carefully after death. In 14 there were decided marks of inflammation of the umbilical arteries, especially of those portions lying along the urinary bladder; in several cases the peritoneum over the arteries was much injected, and in 3 adherent either to the omentum or intestine by coagulable lymph; the coats of the arteries were thickened, their cavities dilated and containing dark reddish-brown or greenish puriform matter, always fetid. Sometimes the arterial tunica interna was found ulcerated and absent in places, and there was spongy thickening of the subjacent connective tissue. In 2 cases the ulcerative process had extended from the tunica interna to the peritoneum, and there was a deposit of thick ichorous matter around the ulcer; in 1 case both arteries were so softened that their coats were scarcely distinguishable, and in another these vessels had become gangrenous. The appearance of the umbilicus was unchanged in 4 cases; in 10 the fundus was red and filled with puriform fluid, which quickly reappeared when removed, and, in general, shortly before death the navel presented a greenish color.

According to Romberg, Dr. Schöller made post-mortem examinations in 18 cases of tetanus infantum, and in 15 found inflammation of the umbilical arteries. These vessels were swollen near the bladder, in 1 case to the diameter of four lines, and were found to contain pus. The lining membrane was eroded or covered with an albuminous exudation. Both arteries were not always equally inflamed, and in 3 cases, only 1 was affected.

Schneeman[1] found minute points of suppuration in the umbilical vein in 8 cases, and pus throughout the course of this vessel in 1.

The observations mentioned above were made, for the most part, in hospitals on the Continent, but similar observations have been made in private practice. M. Borian[2] of the isle of Bourbon says that he has found in every case inflammation around the umbilicus. Dr. John Furlonge,[3] who resided at St. John's, Antigua, attributes the disease to improper dressing of the umbilicus. The same opinion is expressed by Mr. Maxwell,[1] who also saw the disease in the West Indies. Dr. Ransom[2] states in a communication to Prof. John M. Watson that he has never seen a case of tetanus of the new-born in which the umbilicus was healthy. In a case related by Robert S. Bailey[3] there was a hard scab on one side of the umbilicus, and this part was much distended. A discharge followed the removal of the scab, and the child recovered. In a favorable case related by W. B. Lindsay[4] the umbilicus was tumid and not disposed to heal. Dr. H. O. Wooten[5] attributes the disease to the condition of the umbilicus and umbilical vessels, and states that he has found the umbilicus gangrenous. A case has been reported in which the umbilical vessels were blocked up by purulent matter.[6] Robert H. Chinn, M. D.,[7] of Brazoria, Texas, believes one cause of the disease to be improper tying and management of the umbilical cord, by which a diseased state is produced which extends to the umbilicus and thence to the viscera. At a meeting of the Obstetrical Society of Edinburgh, held April 24, 1850, Dr. Imlach related a case in which there was a dark and gangrenous appearance on the integument around the umbilicus, and the peritoneum underneath was also dark, but not inflamed; umbilical vein healthy; a little fibrin in the left umbilical artery; right umbilical artery much diseased; its two inner coats apparently destroyed, and in their place a yellow pultaceous slough in which pus-globules were discovered with the microscope.

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[1] *Holscher's Annalen*, vol. v. p. 484, 1840.

[2] *Gazette médicale*, Paris, July 11, 1841.

[3] *Edin. Med. and Surg. Jour.*, Jan., 1830.

It is evident that the pathological state of the umbilicus and umbilical vessels described above, and which has been noticed by so many observers in different countries, cannot result from the tetanus. It is possible that the puriform substance noticed in the umbilical vessels was disintegrated fibrin, which had coagulated at the time of ligation of the cord, and the cells seen by Dr. Imlach and others may sometimes have been white corpuscles still remaining from the stagnated blood.[8] Still, the evidences of inflammation, in at least a part of the cases related above, were of a positive character.

The belief that umbilical lesions occasionally cause tetanus infantum comports with the well-known traumatic causation of tetanus in the adult. This belief is strengthened by the fact which will appear farther on in our remarks that tetanus of the new-born, from being frequent in certain localities, has become infrequent through greater care in dressing and managing the umbilical cord.

But there are cases of tetanus infantum in which there is no disease in or about the umbilicus. Dr. Finckh of Stuttgart examined the umbilical vessels in eleven cases without discovering any pathological change. Dr. Samuel B. Labatt,[9] master of the Dublin Lying-in Hospital, published a paper entitled "An Inquiry into the Alleged Connection between Trismus Nascentium and Certain Diseased Appearances in the Umbilicus." This paper was designed as a reply to the essay of Dr. Colles. Dr. Labatt relates several cases in which there was no disease of the umbilicus and umbilical vessels, and others in which the disease was so slight that it probably produced no injurious effect on the health of the child. Dr. James Thompson,[10] who spent considerable time in the tropical regions, says: "I have myself examined nearly 40 cases of infants that have sunk under this complaint. In many I have looked at no other part than the navel, and have found it in all states—sometimes perfectly healed, especially if the infants had lived several days; at other times a simple clean wound. When death occurred on the fifth or sixth day the wound was frequently in a raw state. I never yet saw it in a sphacelated condition." This writer concludes from his observations that there are cases in which the cause is located elsewhere than in the umbilicus or umbilical vessels. Dr. John Breen[1] remarks: "From dissections . . . . we have never been able to discover any peculiar morbid appearance which would justify us in offering any explanation of the pathology of the disease." In my own cases there was no evidence of disease of the umbilicus or umbilical vessels, so far as could be ascertained by external examination, and in one (No. 32) a careful post-mortem examination disclosed no lesion of these parts.

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[1] *Jamaica Phys. Jour.*, copied into the *London Lancet*, April 11, 1855.

[2] *Nashville Jour. of Med. and Surg.*, June, 1851.

[3] *Charleston Med. Jour. and Rev.*, Nov., 1848.

[4] *N. O. Med. and Surg. Jour.*, Sept., 1846.

[5] *Ibid*, May, 1846.

[6] *Ibid.*, May 1, 1853.

[7] *Ibid.*, Sept., 1854.

[8] *Virchow's Cellul. Pathol.*

[9] *Edin. Med. and Surg. Jour.*, April, 1819.

[10] *Ibid.*, Jan., 1822.

The inference from the above observations is that, although umbilical disease may be an occasional, probably not infrequent, cause of tetanus neonatorum, cases occur in which such disease is not present, and we must look for the cause elsewhere. From the nature of tetanus neonatorum, the cerebro-spinal axis has been from time to time examined in those who have died of this malady, and occasionally sufficient cause has been found in this part of the system.

I have alluded in another connection to a case from Billard in which tetanic rigidity occurred in an infant three days old as the result of spinal meningitis. That tonic spasms not infrequently occur in older children in consequence of meningeal inflammation is well known, and in some of the reported epidemics of infantile tetanus meningitis was really present, and was doubtless the cause of the tonic spasms. Such an epidemic was observed by Professor Cederschjold in Stockholm in 1834. Within a few months he treated 42 cases, and in addition to the lesions which are known to result from tetanus, there was found in the bodies examined a fibrinous exudation at the base of the brain. Finckh of Stuttgart made 20 post-mortem examinations of those who had died of this disease, and in 9 found spinal meningeal inflammation.

Meningitis in the new-born is, however, rare, and we must regard it as exceptional in cases of tetanus.

In 1846 the late Dr. Marion Sims published a paper designed to show that tetanus neonatorum results from injury of the brain produced by depression of the occipital bone; but I am not aware that this theory has any adherents at the present day. It is true that occipital depression quickly occurs in cases of tetanus, but it appears to be due mainly to the rapid emaciation of the brain and diminished cerebral circulation which attend this disease.

Finckh made post-mortem inspection of 20 cases in the Stuttgart Hospital, the bodies at death having been placed on their faces in order to prevent any deceptive appearance from the gravitation of blood. In 4 he failed to detect any alteration in the spinal cord or its membranes, but in the remaining 16 he found effusion of blood in considerable quantity the whole length of the spinal cord between the bony walls and the dura mater. It should be stated, however, that spinal meningeal inflammation was present in 9 of the 16, though the extravasation did not probably result from the inflammation, but from the tetanus. The blood in Finckh's cases was very dark—sometimes fluid, at other times coagulated. In 1 case no change was observed in the appearance of the brain or its membranes. In the remaining 19 more or less extravasated blood was found on the surface of the brain or in its interior. The substance of the brain was healthy, as also its membranes, except the congestion. The only abnormal appearance observed in the thoracic and abdominal viscera was strong contraction of some portion of the intestinal tube in five cases. Dr. West says: "The most frequent post-mortem appearances in these cases"—referring to tetanus neonatorum—"and that which I found in the bodies of all the four children whom I observed, consist of effusion of blood, either fluid or coagulated, into the cellular tissue surrounding the theca of the cord. Conjoined with this there is generally a congested state of the vessels of the spinal arachnoid, and sometimes an effusion of blood or serum into its cavity. The signs of congestion about the head are less constant, though much oftener present than absent, and sometimes existing in an extreme degree; while in one instance I found not merely a highly congested state of the cerebral vessels, but also an effusion of blood in considerable quantity between the skull and dura mater, and also a slighter effusion into the arachnoid cavity." Dr. Weber of Kiel also placed on their faces infants who had died of tetanus, and without exception, found injection of the capillaries of the cord and spinal meninges and extravasation of blood. M. Matusynski, according to Bouchut, "has observed effusions of blood of variable quantity in the cerebral pia mater, in the ventricles, and in the choroid plexuses, with considerable injection of the membranes of the brain. He has also seen serous infiltration beneath the arachnoid and serous effusion into the ventricles, accompanied by a diminution of the consistence of the cerebral substance." In two cases examined by myself there was intense injection of the cerebral meninges and of the meninges of the upper part of the spine, but no extravasation was noticed. The spinal canal was not opened. In a third case, in which the spinal canal was opened, there was extravasation in addition to the congestion; this was especially observed along the spinal theca.

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[1] *Dub. Jour. of Med. and Chem. Sci.*, Jan., 1836.

Dr. H. O. Wooten[1] states that he has made several post-mortem examinations, and has found the pathological appearances as uniform as in any other disease, as follows: "Engorgement of the substance of the brain and of the meninges lining the base of the brain, the medulla oblongata, and spinal marrow; liver congested."

In a case related by Dr. Imlach before the Edinburgh Obstetrical Society, April 24, 1850, the upper part of the lungs was healthy, the posterior portion congested and containing many dark points; heart and liver healthy; small intestines of a light-brown color; stomach and large intestines pallid; there had been umbilical hemorrhage.

Romberg states that he found in a child whose death occurred from this disease such intense congestion of the veins and sinuses of the brain that a slight touch and the removal of the cranial bones produced extravasation of the partly coagulated and partly fluid blood. Dr. Schöller, on the other hand, found extravasation of blood in the spinal canal in only 1 case in 18.

It is seen from the above observations that tetanus neonatorum is ordinarily accompanied by extreme passive congestion of the internal organs, including the cerebro-spinal axis and its meningeal investment. The embarrassment of respiration and the retarded circulation of blood consequent on the tetanic rigidity afford sufficient explanation of this state of the vessels.

We have stated at length the condition of the various organs in those who have perished from tetanus, as reported by competent observers in different localities, so that, if possible, light might be thrown on the causation of this interesting and fatal malady. But observations more recent than those given above appear to show that tetanus is, sometimes at least, a microbic disease and is communicable by inoculation. Dr. E. Riper of Greifswalde (*Centralblatt für Medicin*, Oct. 15, 1887) states that parts of the navel removed with sterilized instruments from an infant having tetanus communicated the disease by inoculation to six mice. Guinea-pigs inoculated with a little of the tissue taken from the wounds in the dead mice took tetanus five days later. Dr. Beumer (*Berlin. klin. Woch.*, No. 30, 1887) also states that he communicated tetanus to mice and guinea-pigs by inoculating them with tissue from the umbilicus of an infant that died of tetanus. Recently, Verneuil of France has published two papers in which he cites instances apparently showing that tetanus is sometimes derived from the lower animals, especially the horse, and is in other instances communicated by man to the lower animals. Verneuil cites the following interesting example showing the mode of infection: A newly-born child died of tetanus. Its mother took a nurse-child, which soon perished from the same disease. Fifteen days after, the family horse contracted the disease, which was tedious, but it ended favorably. Before it recovered the woman also contracted tetanus, which was protracted, but not fatal. Dr. T. B. Adams, physician to the Foochow Native Hospital, states that tetanus is rare in Southern China, but a patient died of it in one of the hospital wards on Oct. 1, 1887. On Oct. 8th a patient with bleeding piles was assigned to the same little room in which the patient with tetanus had died, and the piles were ligated two days later. Nine days after the operation tetanus commenced, and was fatal. In 1886, Rosenbach produced tetanus in two guinea-pigs by introducing under their skin a little gangrenous substance from the sore of a patient with tetanus. In 1887, Bonome had under observation three patients with tetanus who were wounded by the falling of a church. In the fetid wounds of these patients he discovered, in addition to numerous other bacteria, a slender bristle-like bacillus, thick, straighter, and longer than the tubercle bacillus, and with a rounded extremity, so as to resemble a pin. He was unable to cultivate it, but inoculations with the pus which contained it caused tetanus.

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[1] *N. O. Med. and Surg. Jour.*, May, 1846.

Other observations and experiments similar to the above might also be stated, so that there is little doubt that the tetanus of animals and that of man are identical, and that this disease is inoculable and therefore infectious. Dr. E. O. Shakespeare in a recent paper on traumatic tetanus arrives at the following conclusions: "Traumatic tetanus of animals and of man is at least sometimes, if not constantly, an infectious specific affection, due to the action of a specific infectious virus which exists in the tissues around the seat of the infection, in the blood, and in the central cerebro-spinal system."

The observations detailed above certainly lend strong support to the theory that tetanus is produced by a microbe, but it is stated that Brieger has succeeded in isolating a ptomaïne produced in the cultures of the bacillus of Rosenbach, which ptomaïne has the formula $C_{13}H_{30}Ag_2O_4$, and, injected hypodermically in animals, produces tetanic symptoms (*Annual of the Univer. Med. Sci.*, vol. iii., 1889). But even if it be shown that the immediate cause of tetanus is a ptomaïne, the theory of its microbic origin is not invalidated, since the ptomaïne results from microbic action. That the cause is a micro-organism, and that it may reside in the soil, has been shown by the recent observations of Prof. Wm. H. Welch of Johns Hopkins University, who in his address before the American Medical Association at Newport, June 28, 1889, said: "Among the pathogenic bacteria which have their natural home in the soil, the most widely distributed are the bacilli of malignant œdema and those of tetanus. I have found some garden earth in Baltimore extremely rich in tetanus bacilli, so that the inoculation of animals in the laboratory with small bits of this earth rarely fails to produce tetanus." But whether this disease is produced directly by the agency of a microbe, or by a ptomaïne resulting from microbic action, or occasionally by other causes distinct from either microbe or ptomaïne, it cannot be doubted that the cause is the same in tetanus neonatorum as in that of the adult. We have seen that many observers have regarded uncleanliness as the common cause of tetanus neonatorum, since they have remarked its occurrence when the umbilical dressing was filthy and offensive or the apartments or the surroundings dirty. These observations are compatible with the theory of the microbic origin of tetanus, for microbes find a nidus and are propagated in greatest abundance where insanitary conditions exist.

SYMPTOMS.—In many cases premonitory symptoms are absent or are so slight as to escape notice. In some patients fretfulness precedes the attack, but no more than is often observed in those who continue in good health. The first symptom which alarms the parents and shows the grave nature of the commencing disease is inability to nurse or evident pain and hesitation in nursing. Commencing with rigidity of the masseters, the disease gradually extends to the other voluntary muscles, and in the course of a few hours the muscles of the limbs as well as of the trunk are involved. Persistent muscular contraction, which is the pathognomonic feature of infantile tetanus, is developed not fully in the beginning, but by degrees in each affected muscle, so that it is not till after the lapse of several hours, perhaps even a day, that the greatest amount of rigidity is attained. Therefore in the commencement of the disease the limbs can be flexed and the jaw pressed open more readily than at a subsequent stage, though with manifest pain to the infant.

During the period of maximum rigidity the jaws are fixed almost immovably, often with a little interspace between them, against which the tongue presses and in which frothy saliva collects. The head is thrown backward and held in a fixed position by the stiffness of the cervical muscles. The forearms are flexed; the thumbs are thrown across the palms of the hands, and are firmly clenched by the fingers; the thighs are drawn toward the trunk; the great toes are adducted and the other toes flexed. Occasionally opisthotonos results from the extreme contraction of the dorsal and posterior cervical muscles. The infant can sometimes be raised without any yielding of the muscles by the one hand under the occiput and the other under the heels.

The rigidity is liable to variation in its intensity even after the full development of the disease. If the infant be quiet, especially if asleep, the muscles are partially relaxed to such an extent sometimes, in the first stages of the complaint, that the features have a placid and natural expression, though only for a short time. Frequent exacerbations occur in the muscular contraction, sometimes without any apparent cause, and sometimes produced by anything which excites or disturbs the child. Attempts to open the lips or jaws or eyelids or to bend the limbs, blowing on the face, or even crawling of a fly upon it, occasion the paroxysms.

During the paroxysm the eyelids are forcibly compressed, as well as the lips, which are either drawn in or are pouting; the forehead and cheeks are thrown into wrinkles and the physiognomy is indicative of great suffering. The unnatural positions of the trunk and limbs which result from muscular contraction are increased for the moment; the head is more forcibly thrown back and the limbs more strongly flexed. The muscular movements which occur during the paroxysms are sometimes described as clonic spasms. There is indeed occasionally some quivering of the limbs, and yet, as I have on different occasions noticed, so far from the muscular action being a clonic spasm, it is clearly tonic and is intensified during the paroxysm. In fatal cases the paroxysms occur more and more frequently until the period of collapse.

The crying of the child affected by tetanus is never loud, however great the suffering. It is variously described by writers as "whimpering" or "whining." It is of this suppressed character in consequence of the rigid state of the respiratory muscles and their imperfect movement.

During the exacerbation respiration is suspended, or so imperfect and the circulation so retarded that the surface becomes of a deep-red. almost livid, color. Sometimes epistaxis occurs, affording partial relief to the congestion, and sometimes, though less frequently, the blood forces itself from the congested liver along the umbilical vein and escapes from the umbilicus. The intense passive congestion consequent on the tetanic spasm is general throughout the system, but extravasation of blood appears to be more common around the brain and spinal cord than elsewhere.

The frequency of the pulse and respiration varies in different cases and at different stages of the same case. They are often somewhat accelerated, but at other times are natural, or are even slower than in health.

While the appetite of the infant, to appearance, is not diminished, the pain which it experiences in nursing is such that alimentation is necessarily deficient. It can be fed with a spoon for a time after it ceases to take food in the natural way, but artificial feeding soon fails. The milk placed in its mouth is in great part pressed back through the violence of the spasm which is induced by the attempt to feed it.

In consequence of imperfect nutrition the infant rapidly wastes away. There is no other disease, except the diarrhœal affections, in which the emaciation is so rapid. In a case related by Dr. W. B. Lindsay[1] the record states that "the infant was fat three days before, but was now emaciated." Romberg, who saw tetanus neonatorum in European hospitals, and Robert H. Chinn[2] of Texas, both speak of the rapid emaciation. The trunk and extremities lose their fulness and the features become pinched. Several observers have noticed the appearance of miliaria in this reduced state of system, especially around the shoulders, and sometimes a decidedly icteric hue appears on the skin.

The condition of the intestines is not uniform. They may be relaxed, particularly if the disease be due to some irritation in them; in other cases the stools are natural or constipated.

It is often difficult to ascertain the state of the eyes, since attempts to open the eyelids bring on spasms and cause firm compression of the lids against each other. According to Sir Henry Holland, one of the first symptoms which occurred in cases on the island of Heimacy was strabismus, with rolling of the eyes. But this statement must be received with caution, since these cases were not seen by any physician and the information was obtained from the parents and priests. If true, the proximate cause of the disease in Heimacy would seem to be located in the cerebro-spinal axis. Contraction of the pupils commonly occurs in the stage of collapse.

Mode of Death.—Death in infantile tetanus may occur from apnœa in the paroxysms, from extreme congestion of the cerebral vessels, or apoplexy; and, lastly, it may occur from exhaustion. The last mode is probably the most frequent.

Prognosis.—All writers till recently agree that tetanus of the infant rarely terminates favorably. Cullen attributes the ignorance of physicians in regard to this disease to the fact that it is so little amenable to treatment that they are not usually summoned to attend those affected with it. In the island of Heimacy, of 185 cases occurring during a series of years about the commencement of the present century, not one survived; and in the same locality, at Westmannoe, a small islet, 64 per cent. of all the infants born died of trismus (report of Dr. Schleisner). Similar statements in regard to the mortality of tetanus infantum are given by physicians in the Southern

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[1] *N. O. Med. Jour.*, Sept., 1846. [2] *N. O. Med. and Surg. Jour.*, Sept., 1854.

States. Dr. H. O. Wooten[1] of Alabama says that he has "never seen a decided case of tetanus nascentium that did not prove fatal. . . . . and that it is very generally deemed useless to call in medical aid after the initiatory symptoms are well declared." Mr. Maxwell,[2] speaking in reference to the West Indies, says: "From observations which I have made for a series of years, ... I found that the depopulating influence of trismus nascentium was not less than 25 per cent. It scarcely has a parallel within the bills of mortality." Dr. D. B. Nailer[3] says: "About two-thirds of the deaths among the negro children are from this disease, and so uniformly fatal is it that a physician is never sent for."

Yet death does not always result: eight of the forty cases in my collection recovered; but a correct opinion cannot be formed from this of the actual ratio of favorable to unfavorable cases, since favorable cases are much more likely to be published. In the history of these 8 cases two interesting facts are noticed, which when present may serve as a ground for hope of a successful termination. These were, the age at which the disease began and the fluctuation of the symptoms. With two exceptions, the infants who recovered were about a week old when the initiatory symptoms appeared, and there were fluctuations in the gravity of the symptoms; whereas fatal cases ordinarily grow progressively worse. Yet in favorable cases the symptoms are never so severe as they become in a few hours in those who succumb.

Duration in Fatal Cases.—Of 18 cases observed by Finckh in the Stuttgart Hospital, 15 died in two days, 2 in five days, and 1 in seven days. During the epidemic in the Stockholm hospitals in 1834, where 42 cases were treated, the disease seldom lasted more than two days. Romberg says: "It generally lasts from two to four days, but its duration is at times limited at from eight to twenty-four hours, and occasionally, though rarely, it extends from five to nine days."

In 31 fatal cases in my collection, in which the duration is mentioned—

1 lived	3 hours.
11 others lived	1 day or less.
12 lived	2 days.
4 lived	3 days.
3 lived	4 days.

Both Underwood, who published a treatise on diseases of children in 1789, and Dr. Elsässer at a more recent date, recorded fatal cases which were unusually protracted. The one described by Underwood was treated in the British Lying-in Hospital, and, although all the others treated in this institution died by the third day, this lived six weeks; but it is suggested by the author that death was due in part to some other affection. The child treated by Elsässer lived thirty-one days.

Duration in Favorable Cases.—In the 8 favorable cases in my collection the duration of the disease, reckoned from the time when the infant ceased nursing till it began again, was as follows: In 1 case, two days; in 1, a few days; in 1, fourteen days; in 2, fifteen days; in 1, twenty-eight days; in 1, twenty-one days; and in the remaining case, about five weeks.

Diagnosis.—To one who has seen this disease in the new-born or is familiar with its symptoms diagnosis is easy. The symptoms which possess diagnostic value are more manifest and reliable than in most other infantile maladies. Permanent rigidity of the voluntary muscles, with temporary exacerbations, such as have been described above, which are induced by any cause which disturbs the infant—as attempts to open the mouth or eyelids—is pathognomonic.

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[1] *N. O. Med. Jour.*, May, 1846.

[2] *Jamaica Phys. Jour.*, copied into the *London Lancet*, April 11, 1835.

[3] *N. O. Med. Jour.*, Nov., 1846.

Preventive Treatment.—While tetanus neonatorum, if fully developed, is ordinarily fatal in spite of any remedial measures heretofore used, there is no doubt of the efficacy and value of preventive measures when properly employed. This was shown by the great reduction in mortality in the Dublin Lying-in Hospital through the thorough ventilation introduced by Dr. Clarke. Dr. Meriwether[1] of Montgomery, Ala., says: "When the disease appears endemically on a plantation it may be arrested by having the negro houses whitewashed with lime inside and out; by raising the floors above the ground; by removing all filth from under and about the houses; by particular attention to cleanliness in the bedding and clothing of the mother; and in the dressing of the child, so as to prevent any of the matter from the umbilicus lying long in contact with the skin. Many physicians, especially in the Southern States, speak confidently of care in dressing the cord and attention to the umbilicus as a means of prevention. Grafton[2] says that he has "never known the disease to occur in any child whose navel had the turpentine dressing." He uses turpentine as follows: "At the first time a few drops of undiluted turpentine are applied immediately to the umbilicus around the cord, and it is anointed at every succeeding dressing, the turpentine being diluted one-half or two-thirds with olive oil, lard, or fresh butter." This use of turpentine has also been recommended by other practitioners in warm regions.

Dr. John Furlonge[3] of St. John's, Antigua, believes that no case would occur with the following treatment: "The cord, when divided, should be wrapped in clean linen. Every night for two weeks one or two drops of tinct. opii and spts. vini, equal parts, should be given, and castor oil, with a little magnesia, every morning. The child must be washed in tepid water every morning and the funis dressed." If this treatment be attended by the success which is claimed for it by Dr. Furlonge, so great care in dressing the cord is certainly well repaid in localities, as at Antigua, where a large proportion of the infants die of tetanus.

Some experienced observers go so far as to assert that it is possible to ward off tetanus neonatorum after the occurrence of premonitory symptoms. Dr. Dowell[4] says: "Some with slight twitchings of the muscles have recovered without any trouble by being put into a mustard-bath, washed clean, and put in a clean and well-ventilated cabin."

Treatment.—In considering the effect of medicinal agents which have been employed in the treatment of infantile tetanus, the great difficulty which the child experiences in swallowing should be borne in mind. Without care a considerable part of the dose is lost by the spasm of the muscles of deglutition, which ordinarily occurs when the spoon is placed in the mouth, so that, unless special attention be given to this matter, it is uncertain whether the prescribed dose is fully administered.

The treatment employed by different physicians has been very diverse. Antiphlogistic remedies were prescribed by Finckh, but every case so treated was fatal. He states that whenever blood was abstracted, even in small quantities, the symptoms were aggravated. The same result has followed depletory measures in the practice of other physicians.

The internal remedies which have been most frequently prescribed are opiates and antispasmodics. Furlonge in a favorable case gave laudanum in doses of one drop every three hours alternately with two grains of Dover's powder. Woodworth also gave one-drop doses of laudanum; Eberle, one-sixth of a drop hourly. The opiate has generally been given in combination with an antispasmodic. The Dover's powder given every three hours by Furlonge was combined with five grains of sulphate of zinc. The hourly doses of laudanum by Eberle were combined with six drops of tincture of asafœtida.

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[1] *Amer. Jour. of Med. Sci.*, April, 1854.
[2] *N. O. Med. and Surg. Jour.*, July, 1853.
[3] *Edin. Med. and Surg. Jour.*, Jan., 1830.
[4] *Amer. Jour. of the Med. Sci.*, January, 1863.

When anæsthetics began to be employed in the treatment of diseases, it was believed that they would be especially useful in cases of tetanus. Accordingly, chloroform has been used in tetanus in the infant, with the effect of controlling the spasm during the time of its use, but without curing the disease. In Case 7 in our first table it was employed several times, but apparently without delaying the fatal result. The editor of the *New Orleans Medical and Surgical Journal* states, in the May issue of that periodical for 1853, that he has used chloroform in tetanus neonatorum, with the effect, he believes, of prolonging life. Anæsthetics certainly relieve the suffering of the infant, and on this account, even if they do not prolong life, their judicious employment seems proper.

The remedy which, in my opinion, is far preferable to all others is hydrate of chloral. Since the introduction of this agent into therapeutics it has been employed by several physicians in the treatment of this disease with so good a result that it will probably supersede all other medicines for this purpose. Dr. Widerhofer[1] of Vienna states that he has saved six out of ten or twelve by the use of chloral. He prescribes it in doses of one to two grains by the mouth, or, if there be great difficulty in swallowing, two or four grains by the rectum. Dr. F. Auchenthaler[2] relates a case in which he gave even six-grain doses, and in nine days the disease had entirely disappeared. I have recently employed hydrate of chloral in a case of tetanus, giving it in half-grain doses every two hours, except when there was profound sleep. The disease was fully developed and the symptoms severe when I was called. I did not believe that the infant with the old remedies would live more than two days, but by the chloral life was prolonged nearly one week. Moreover, by the use of chloral the suffering of the infant is greatly diminished. The frequent inhalation of sulphuric ether also aids materially in controlling the spasms.

The administration of alcoholic stimulants is required at short intervals on account of the rapid emaciation and great prostration.

Local treatment directed to the umbilicus in those cases in which there is evidence of inflammation of the umbilicus or umbilical vessels should not be neglected. The application of an emollient poultice to the umbilicus has been followed by apparent improvement, if we may believe the statement of some physicians who have made use of this treatment. Dr. Meriwether of Alabama says if there be no improvement from the medicine which he orders he applies a blister, larger than a dollar, to the umbilicus, and with this treatment the child generally improves—a remarkable statement, since so few improve at all.

A warm foot-bath, repeated at intervals of a few hours, and stimulating embrocations along the spine, are proper adjuvants to the treatment.

Sclerema Neonatorum.

This is a rare disease, and most of the cases which have been observed have occurred in foundling asylums or maternity wards. It is characterized by induration or rigidity of the skin and subcutaneous tissue over a greater or less extent of the system. The sensation communicated to the finger pressed upon the affected surface is not unlike that produced by the cadaver. Those having the disease are feeble, poorly nourished, and a considerable proportion are prematurely born. Their temperature is below normal.

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[1] *London Lancet*, March 18, 1871.

[2] *Jahr. f. Kinderheil.*, N. S., iv.

Sclerema of the newly-born was first described by Underwood in the eighteenth century, and following him, in 1781, Andry applied this term to œdema occurring in the first days after birth, and which should not be confounded with sclerema. Sclerema neonatorum occurs in emaciated or atrophic infants, but the skin over the affected part, instead of lying in wrinkles or folds, as is usual in a state of great emaciation or atrophy, becomes smooth and is firmly adherent to the subjacent parts, from which it cannot be raised. The induration usually first appears in the lower extremities, and it passes upward along the hips and lumbar region, and it may occur not only upon the trunk and upper extremities, but even upon the face. The limbs are extended and immobile, and the soft parts, firm and resisting, do not pit on pressure. The skin has a dusky-yellow color and is perhaps slightly cyanotic. The respiration is feeble and slow. The rigidity when extensive resembles that in tetanus. Nursing from the breast is imperfectly performed, and when the muscles of the face and lips are involved is impossible. The causes of sclerema appear to be prematurity, atrophy or poor nutrition, and great heart failure.

This disease, so long as the patient is able to take nutriment, may continue for weeks before the fatal ending, with a constant abnormally low temperature.

Parrot made post-mortem examinations, and found hardening and atrophy of the skin and rete Malpighii, the cells pertaining to which being indistinct and forming a firm mass. In the adipose tissue underlying the skin the fat had disappeared to a considerable degree, the fat-cells being atrophied, but having distinct nuclei. The fibres of the connective tissue were apparently increased in number and thickness. The blood-vessels, particularly in the papillæ, were shrunken or narrowed to such an extent that their lumina were not visible. Henoch made a post-mortem examination of the brain and spinal cord in two cases which had lain for weeks in his ward in a rigid state, and found them normal.

A clear idea of the symptoms and anatomical characters of sclerema can be obtained by the narration of a typical case that occurred in the New York Foundling Asylum. Dr. W. P. Northrup, the curator, gave a full and graphic description of this case at the first session of the American Pædiatric Society: The patient, a female, was brought to the asylum as a foundling at the age of five days. It was jaundiced, had sprue, and a rectal temperature of 96½° F. The efforts to increase its temperature were unavailing, and two days later it was carefully examined. Its face was cold and rigid, and the coldness and rigidity had extended over not only the features, but the scalp, shoulders, arms, hands, hips, thighs, legs, and feet. The extremities were so stiff that pressure upon them or attempts to move them communicated the sensation of a cadaver or half-frozen tissue. Its eyes were closed; its surface had a dirty, yellowish-brown color. When handled it uttered a feeble whimpering cry, but was otherwise motionless and quiet; no pulse; rectal temperature below the lowest figure on the thermometer; respiration feeble and shallow. Death occurred two days later, at the age of nine days.

At the autopsy the sclerema was found to be less in the abdominal walls than elsewhere. On incising the hardened tissues no blood or serum escaped from the cut surface. The lungs had been fully inflated, no collapse being present, and they contained dark hemorrhagic points or spots. Nothing unusual was observed in the skull, brain, heart, and great vessels, the stomach, intestines, liver, and kidneys, except the urates in the tubuli uriniferæ. The hemorrhagic extravasations in the lungs were found to consist of fresh blood in the alveoli and connective tissue. Dr. Northrup made microscopic examinations of the skin and subcutaneous tissues, and found that they took injections well, showing a normal vascular network. The microscopic slides have been examined by expert microscopists and dermatologists, and they can discover nothing abnormal that throws light on the cause or pathology of the sclerema.

Sclerema bears considerable resemblance to œdema of the new-born. In œdema the temperature is low and the œdematous tissues may present considerable firmness, but the surface usually pits on pressure, unlike that in sclerema. Of the different opinions expressed by observers in reference to the cause and pathology of sclerema, that expressed by Ludwig Langer in 1881 (*Wiener Sitzungsbericht*, 1881) is the most plausible. It is as follows: In the adult oleic acid is the chief constituent of the adipose tissue, but in the newly-born the fat contains a large proportion of palmatin and stearin, which solidify when the heat of the body undergoes a moderate reduction below the normal.

Infants having sclerema after lingering for days or weeks die in a state of extreme weakness. I am not aware that recovery has occurred in any case of genuine sclerema of the new-born. Still, it is proper to increase the temperature by warm applications to the body and limbs and to endeavor to improve the nutrition in every possible way. Perhaps a more abundant breast-milk or breast-milk of a better quality can be obtained, and a few drops of Tokay or other good wine or of brandy may be given every second hour.

Œdema Neonatorum.

In this disease thickening of the integument occurs and the subcutaneous connective tissue is infiltrated with serum. The œdema in most cases is at first in the legs, from which it extends along the thighs to the genitals. It may extend over the trunk, upper extremities, and cheeks, but in some cases it appears only in the hands and feet, producing tumefaction of the palms of the one and soles of the other. If the amount of serous infiltration be great, the tissues may be firm and resisting, communicating to the touch a sensation similar to that in sclerema; but when the infiltration is less in degree the tissues are soft and doughy. The skin has a dusky or yellowish color, and sometimes, when much distended, it has a shiny appearance. In cases of great œdema the movement of the affected part is diminished, but not to the same extent as in sclerema. As in sclerema, the temperature is below the normal.

In fatal cases the adipose tissue is found of a brownish, yellowish, or reddish-yellow color, from which a yellowish serum exudes. Œdema of the newly-born does not appear to result from the same cause in all instances. Occurring in feeble, ill-nourished infants, it apparently results, in most instances, from extreme heart-weakness. The feeble circulation leads to venous congestion and consequent serous transudation. Pulmonary atelectasis, occurring as it usually does in ill-nourished and feeble infants, is also an occasional factor in producing venous stasis and transudation of serum. Elsässer has shown that occasionally in the newly-born the œdema results from nephritis, as it frequently does in the adult. Henoch relates the case of an infant of four weeks who had "marked œdema of face and limbs," with serous effusion in the pleural, pericardial, and peritoneal cavities, and compression of the left lower lobe, resulting from parenchymatous nephritis. Another occasional cause of the œdema is erysipelas. This cause is revealed by the dark-red color of the skin characteristic of erysipelatous inflammation.

Recently Prof. Dumas in an elaborate paper on œdema of the new-born arrives at the following conclusions: "1. Œdema of the new-born is only one of the symptoms of a phlegmasia alba dolens which is developed during the first days after birth. 2. Its causes are of the same nature as in the adult, and may be divided into predisposing and determining varieties. Among the latter, the principal one consists in the incomplete establishment of respiration or in the pathological or other causes which this function encounters. 3. The symptoms of phlegmasia in the new-born are the same as in the adult, excepting certain modifications with respect to the special physiology of the first days following birth. 4. The pathological anatomy is also about the same, but the venous thrombosis in the new-born is more frequently located in the inferior vena cava than it is in the same disease in the adult." It does not seem improbable that Prof. Dumas's explanation is applicable to a considerable proportion of cases, the formation of clots in the veins producing such obstruction and venous congestion that serum transudes as a consequence. Dumas recommends, in order to prevent this disease, "suitable care to effect respiration in the new-born at the moment of birth, and not too hasty ligation of the cord."

Œdema, like sclerema, is ordinarily fatal, but occasionally, as when it results from erysipelas, recovery is possible. The treatment should be largely hygienic and dietetic. An abundant supply of good breast-milk should be obtained, or if this be impossible peptonized cow's milk. As in sclerema, artificial warmth and moderate alcoholic stimulation are required.

PEMPHIGUS NEONATORUM.

Pemphigus occurs in two distinct forms in the newly-born, which may be properly designated *pemphigus simplex* and *pemphigus cachecticus.*

Pemphigus Simplex commonly occurs between the ages of two and twelve days. The vesicles, which vary in size from that of a pea to a hazelnut, appear in some cases nearly simultaneously, but in other instances in successive crops. When fully developed, they ordinarily have a transparent yellowish color, and they may appear upon almost any part of the surface except the palms of the hands and soles of the feet. When the eruption is nearly general upon the surface, as it occasionally is, one or two blebs may even appear upon these parts, but as a rule in pemphigus simplex the palms of the hands and soles of the feet are not affected.

In investigating the causes of this form of pemphigus we are struck with the fact that in a considerable proportion of the recorded cases those affected with it appear to be otherwise in perfect health. Occasionally in maternity hospitals it occurs as an epidemic. Thus, Ahlfeld observed twenty-five cases during two months in an institution in Leipzig. The mothers of these infants were apparently healthy, and the pemphigus commenced in all between the second and fourteenth days after birth. The palmar surfaces of the hands and plantar surfaces of the feet were not affected in any of these cases, though vesicles appeared on the fingers in some of them. Ahlfeld, from these observations, believed that the disease was infectious or of a miasmatic nature. Koch states that thirty-one cases occurred in the practice of a certain midwife, while in the practice of other midwives no case occurred. Weyl of Berlin, aware of facts like the above, states that the disease is undoubtedly contagious. Bohn, on the other hand, regards cutaneous irritants as a cause, and he states that the repeated occurrence of pemphigus in the practice of a certain midwife was traced to the fact that she habitually used water too hot in bathing the infants. But there is now a sufficient number of observations to render highly probable, if they do not demonstrate, the contagious nature of pemphigus in certain cases. Roeser always found micrococci in the serum of the vesicles. Gibier found chain bacteria, single bacteria, and also bacteria in zooglœa in the vesicles. Scharlau met the disease in different members of a family, and succeeded in inoculating himself from the vesicular contents. We may conclude, therefore, that pemphigus of the newly-born is probably in certain cases microbic and inoculable, though the microbe which causes the disease has not been fully identified. But in some instances it is not improbable that the disease is produced by causes not microbic, as from cutaneous irritants. Further investigations in regard to the etiology of pemphigus simplex are required before positive statements can be made.

Pemphigus simplex is usually attended by little constitutional disturbance, but sometimes, it is said, a slight fever attends the eruption of the vesicles. The skin adjacent to the vesicles may have the normal or a slightly congested or vascular appearance. The vesicular contents escape in a few days by rupture of the vesicle, or disappear by absorption, and the detached cuticle forms a thin scale which is soon thrown off, and in a few days replaced by a new growth of cuticle.

Pemphigus Cachecticus.—This form of pemphigus occurs in infants who have a profound cachexia, and this cachexia is in a large proportion of cases due to inherited syphilis. Unlike pemphigus simplex, it attacks by preference the palms of the hands and soles of the feet. It also occurs upon thin portions of the skin, as the groin, axilla, and neck. The surface upon which the vesicles are situated presents a reddish or livid appearance, and the vesicles are only partially filled. The exuded liquid is not so clear as in pemphigus simplex, and it is often turbid or even bloody. The vesicles or remains of vesicles are sometimes observed at birth, and are then believed to have a syphilitic origin. When the cause is syphilis other manifestations of this disease may be also present.

Pemphigus cachecticus may be prolonged several weeks, if the patient live, by the occurrence of new vesicles. It is important, as regards the selection of remedies, to bear in mind the fact that the profound dyscrasia which underlies and gives rise to an attack of pemphigus cachecticus may occur from other causes than syphilis, as perhaps struma. The evils which attend a family subjected to a life of poverty in a great city, as overwork, scanty and poor diet, overcrowding, and foul air, may be the cause of the dyscrasia in the infant born under such circumstances, even when the parents are actuated by the best motives and endeavor to lead a correct life.

ANATOMY.—The vesicles occur in the epidermis between the layers of the stratum granulosum and stratum lucidum (Weyl). The contents of the vesicles consist largely of serum, but sometimes also of other substances, as pus-cells, epithelial cells, etc.

TREATMENT.—This is simple, consisting of cleanliness, the use of abundant pure breast-milk, and frequent dusting the surface with a powder consisting of bismuth and lycopodium. In the cachectic form of pemphigus, especially if the vesicles have an unhealthy appearance, they should be broken, and their surface may be dusted with a powder of one part of iodoform and ten of bismuth. In syphilitic cases Henoch recommends the addition of 1 gramme (15 grains) of corrosive sublimate to the bath employed. The use of a few drops of Tokay wine or other alcoholic stimulant at each nursing is also required in the cachectic cases.

PART III.

CONSTITUTIONAL DISEASES.

SECTION I.

DIATHETIC DISEASES.

CHAPTER I.

RACHITIS.

Rachitis, or rickets, is regarded as a constitutional disease, though the most prominent symptoms and lesions which characterize it pertain chiefly to the osseous system. It occurs in the first years of life, and therefore during the period of most active growth of the skeleton. It is manifested by an abnormal nutrition and changed physiological action of the bone-producing tissues—namely, the epiphyseal cartilage and the periosteum—and by the arrest, more or less complete, of the deposition of lime-salts in these tissues.

Frequency of Rachitis.

Rachitis is a common result of faulty diet and of antihygienic conditions, and is therefore frequent among the poor of cities, and especially in families who dwell in crowded tenement-houses. It has heretofore been prevalent in the city infantile asylums, but of late years, as regards at least the city of New York, it is much less common, in consequence of the greater attention now given to sanitary requirements in the management of these institutions. Mild cases of rickets are often overlooked, since physicians may not be summoned to attend them, while, even if they be summoned, many who have not given particular attention to this disease are apt to err in diagnosis and to refer the symptoms to some other than the true cause. Commencing gradually and insidiously, rachitis not infrequently continues for months, even in its typical form, before a correct diagnosis is made. In the absence of deformity, which is a late symptom, the fretfulness, tenderness of surface, and perspirations receive a wrong explanation. Practitioners who have heretofore given little attention to this malady..and who believe it to be rare, if they are instructed in reference to its characteristic signs, and look for them in their visits among the city poor, are surprised at the number of cases which they meet. A few years since in the New York Infant Asylum my attention was directed to a rachitic child whose head had so changed from the normal shape that the nurses, as well as the physician, had remarked the difference. Prompted by the occurrence of this case, which had gradually developed under my eyes, I made a careful examination of all the infants, and discovered, what I had not previously suspected, that about one in nine had become rachitic. In most of the infants the disease was mild, but with symptoms so characteristic that it was readily recognized. By effecting certain improvements in the diet, among which was the daily allowance of beef tea to the older infants, rachitis, unless of a mild type, has since been rare in this institution.

The late Dr. John S. Parry of Philadelphia stated that at least 28 per cent. of all the children between the ages of one month and five years who came under his observation in the Philadelphia Hospital during the three years preceding the publication of his paper, in 1872, were rachitic. This is certainly a larger proportion of those who present indubitably rachitic symptoms than occurs in any of the three New York institutions for children with which I have an official connection. In the New York Foundling Asylum, with its sixteen hundred inmates, and in the Bureau for the Relief of the Out-door Poor, where over eight thousand children are annually treated, rachitis is certainly less frequent than is indicated by the statistics of Dr. Parry. In Europe, from the testimony of many observers, both continental and British, rickets is very common among the families who seek medical advice in the institutions of charity. Ritter von Rittershain finds that 39 per cent. of all the children who are brought to the Prague Medical "Poliklinik" are rachitic, and Prof. Henoch states that the proportion is equally large in the families of Berlin who are in similar reduced circumstances. According to Dr. Gee, whose statement was, however, made as far back as 1867–68, of the patients under the age of two years in the London Hospital for Sick Children, 30.3 per cent. are rachitic. Both Dr. Hiller and Sir William Jenner not only allude to the frequency of rachitis, but state that it is the cause of many deaths in London families. Chalybæus states that of nearly three thousand children in Dresden brought to him for vaccination, 8.4 per cent. exhibited signs of rachitis. In an interesting communication read at the meeting of the Ninth International Medical Congress in 1887, Dr. Moncorvo of Brazil stated that 45 per cent. of the sick children treated by him in Rio Janeiro had rachitis. In New York City rachitis is very common in the families of Italian immigrants. According to my observations in the Bureau for the Relief of the Out-door Poor, a majority of the most pronounced cases, attended with great enlargement of the joints and marked curvatures, come from the Italian tenement-houses.

Frequency.

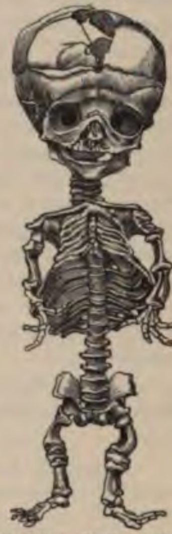
But rachitis does not occur exclusively among the poor. Children of well-to-do families are also liable to it, provided that the conditions soon to be enumerated are present. Ignorance or disregard of the hygienic requirements of young children, and especially the use of improper diet, leads to the development of rachitis in wealthy as well as in destitute families. Merei, in his treatise on the *Disorders of Infantile Development* (London, 1855), states that in Manchester, where his observations were made, one child in every five in families in comfortable circumstances present rachitic symptoms: and he believes that this cannot be much above the real proportion in "the whole of the wealthy classes."

Rachitis, in its milder form, is not uncommon in affluent families in this country, the cause of the delayed dentition, the fretfulness, and perspiration not being suspected in many instances, as I have had opportunities to observe. Often family physicians are not consulted in reference to such symptoms, and when they are called in so little attention has rachitis received on the part of many practitioners that they are very apt to overlook the true pathological state which is present. Still, admitting the fact that many cases are not diagnosticated, I repeat that, though rachitis is not uncommon on this side of the Atlantic, its percentage of frequency falls below that observed in European cities—a fact which may be due to less crowding in their domiciles and to a more liberal and better supply of food among the families of the poor in this country.

AGE AT WHICH RACHITIS OCCURS.

Rachitis is, with few exceptions, a disease of infancy, commencing prior to the age of two and a half years. Now and then it, or a state closely resembling it, occurs in the fœtus, causing deformities such as are present in typical cases. In the Kinderspital Museum at Prague is a specimen showing this, and described by Ritter. Hink and Winkler also describe such cases, and Virchow alludes to a specimen in the Wurzburg Museum which exhibits such deformities as characterize rachitis. Bednar even regards fœtal rachitis as not uncommon (Hillier, Parry). In the Wood Museum of Bellevue Hospital is a skeleton which is probably similar to those in the Prague and Wurzburg Museums. It shows in a striking manner the deformities of this congenital disease. The case occurred in my practice, and the dissection was made by Prof. Francis Delafield. The infant, born at term, died a few hours after birth from atelectasis, apparently produced by the contracted state of the thoracic walls. The parents were hard-working English people whose mode of life and surroundings were such as are known to conduce to rachitis. They were free from syphilitic taint. The accompanying woodcut (Fig. 10) represents this skeleton.

FIG. 10.



Skeleton of a Rachitic Infant which died a few hours after birth.

The following remarkable case of supposed fœtal rachitis was related to me by Heitzmann, whose interesting experiments will be presently detailed :

CASE 1.—A woman who had frequently inhaled the vapor of lactic acid each day for many months, as she was employed to feed animals with this agent, gave birth to an infant at term which died immediately after it was born. It exhibited the signs of congenital rachitis in a high degree. The skull-bones were completely absent; in the cartilages of the bones of the extremities and in those of the ribs there were scanty depositions of lime-salts. The death of the child was evidently due to the absence of the skull-bones, inasmuch as the pressure of the womb during delivery had caused cerebral hemorrhage. All the organs of the chest and abdomen were found in full development and healthy.

We will see hereafter that the theory which attributes rachitis, in certain instances, to a chemical irritant is substantiated by experiment, and that it has already been shown that two such agents, phosphorus and lactic acid, may cause this disease. Now, as the irritating action of phosphorus on the osseous system occurs when it is inhaled in the form of vapor as well as when received in the ingesta, so lactic acid, if the above case be rightly interpreted, produces its special effect upon the bone-producing tissues when inhaled as decidedly as when received in the ingesta or generated in the system. These remarks seem necessary for an understanding of this unusual case, although they anticipate what will be said under the head of Etiology. In the *New York Journal of Obstetrics* for November, 1870, Prof. Abraham Jacobi also published the description of a case of congenital rachitic craniotabes. Whether or not we accept as genuine all the reported cases of fœtal rachitis, there can be little doubt, from the number of observations already made and carefully recorded and from the opinion of high authorities like Virchow, that such cases do occur.

Recently Schwarz examined five hundred newly-born infants in the obstetric clinic in Vienna, and he states that only 19.4 per cent. were entirely free from signs of rachitis. This remarkable statement we hesitate to accept, thinking that there may have been some error in the observation.[1]

Enlargement of the costochondral articulations, known as the "rachitic rosary," which is one of the earliest and most reliable signs of rickets, has been observed, though rarely, in infants only a few weeks old. Dr. Parry saw it as early as the sixth week after birth,[2] and Dr. Gee at the third or fourth week.[3] This should not, however, be regarded as a sign of rachitis, unless the enlargement be so great that it can be readily appreciated by examination through the integument or by sight, for in young children, with the bones in the process of normal development, these joints usually have a diameter a little larger than that of the ribs. Rachitis, with few exceptions, begins within the first eighteen months of life. Though first detected and diagnosticated at a later date, it will ordinarily be ascertained, on inquiry, that its symptoms had an earlier beginning. Still, according to certain observers, it may have a considerably later commencement. Glisson, Portal, and Tripier state that they have seen it commence in children who were well on toward the age of puberty. Sir William Jenner states that he has seen children of seven and eight years who were only beginning to suffer from rachitis.[4]

The following are the aggregate statistics of Bruennische, Von Rittershain, and Ritsche, relating to the age at which rachitis occurs:

	No. of Cases.
During the first half year	99
" second half of first year	259
" " year	342
" third year	134
" fourth year	31
" fifth year	17
Between the fifth and ninth years	21
Aggregate	903

CAUSES OF RACHITIS.

INHERITANCE.—In some infants there is an undoubted hereditary predisposition to rachitis. Feeble digestion and defective assimilation in the infant—which are, as we shall see, important factors in producing the rachitic state—are often traceable to disease or cachexia of one or both parents. The offspring of a tubercular, syphilitic, or otherwise enfeebled parent is more likely to become rachitic than those of healthy and robust ancestry; and it appears that disease of the mother is more likely to entail a rachitic predisposition than that of the father. Among the parental causes may be mentioned poverty, hardships, and defective nutrition of either parent, age of the father, and exhausting discharges of the mother, such as purulent, hemorrhoidal, or uterine fluxes.

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[1] *Annual of Med. Sci.*, 1889.

[2] *American Journal of the Medical Sciences*, January, 1872.

[3] *St. Bartholomew's Hospital Reports*, vol. iv.

[4] *Lancet*, December 11, 1880.

FOOD.—Of the exciting causes, the most common is the use of food not sufficiently nutritive, or, if nutritious, not suited to the age and digestive powers of the child. N. Thin and poor breast-milk and artificial food of poor quality or not suitable for the stage of growth and development are common causes of rickets. Those children who have been prematurely weaned, and who have been given a food which is not a proper substitute for the natural aliment, and those too long wet-nursed and not allowed the additional nutriment which they require, are especially liable to this disease. Those whose digestive power is feeble from whatever cause are more liable to become rachitic than those who, in a state of robust health, have a hearty digestion. N. Hence we meet with rickets as a sequel of various protracted and exhausting maladies during infancy.

It might be supposed, from the nature of rachitis, that the use of food deficient in phosphoric acid and lime is the common cause of rachitis; but facts show that this is not the correct view of its etiology as it commonly occurs, although in its treatment these agents are of undoubted value. The disturbed and altered nutrition of the osteoplastic tissues—namely, of the epiphyseal cartilage and the periosteum—is the important factor in producing the rachitic bone disease, and this may occur although the ingesta contain a sufficient amount of phosphoric acid and lime. Deficiency of these substances probably tends to diminish the amount of lime-deposition, but it is not the essential element in the causation of the malady. This is to be found in the unhealthy condition and action of the cartilage and periosteum, or rather in the agencies, now partly ascertained, which produce the abnormal state and altered nutrition of these tissues.

Cheadle believes that the chief cause of rachitis is bad feeding. Hand-fed infants, he says, are especially liable to it, particularly if their diet be farinaceous. W. H. Peters reports a case caused, he thinks, by feeding with undiluted cow's milk. The child, eight months old, was ordered milk and lime-water, equal parts, and in three months, the signs of rachitis had disappeared.[1]

The important fact has been ascertained by experiments on young animals that rachitis can be produced, as I have already stated, by at least two chemical agents, which may be admitted into the system in the ingesta, and which exert an especially irritating action on the osteoplastic tissues. Senator states, in Ziemssen's *Encyclopædia*, that "Wegner . . . . has recently brought experimental evidence to show that true rickets may be artificially produced by the continued administration of very minute doses of phosphorus, ... together with a simultaneous withdrawal of lime from the food." The fact being established that it is possible to produce rickets by certain deleterious principles in the ingesta opens an interesting field for experimental inquiry. Since improper feeding and indigestion are known to sustain a causative relation to rachitis, experiments have been made to ascertain whether some chemical agent, developed in the system during the digestive process or introduced with the food, may not cause rachitis as it ordinarily occurs in the infant. Among the foremost in that line of experiment has been Dr. Heitzmann, a resident of Vienna when his observations were made, but now of New York.

In young children acids, especially the lactic, are commonly produced, and often in large quantities, as the result of improper feeding, of indigestion, and of intestinal catarrh. The acidity of the infant's stools under such conditions of ill-health is well known. What more natural, then, than the supposition or belief that this acid, thus generated, sustains the same causative relation to rickets as phosphorus in the experiments which have been made with that agent. But the acid which is produced so abundantly in disturbed states of the digestive apparatus in the infant, believed to be chiefly the lactic, must, in order to reach the bones and influence their nutrition, pass through the blood, which is always alkaline. This difficulty in the way of the theory that lactic acid is the irritating agent is removed by physiologists, who tell us that among the organic acids the existence of lactic acid in healthy blood is not entirely beyond doubt, but that it has been found in the latter under abnormal conditions.[1] Lactic acid has also been found, after having made the circuit of the system, in the excretion from the kidneys.

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[1] *Annual of the Univer. Med. Sci.*, 1889.

Heitzmann, in order to ascertain whether this acid sustained a causal relation to rickets, made a series of experiments which have passed into the literature of this disease, and he has kindly furnished me with their details, as follows:

"Marchand, Ragsky, Lehman, Simon, and others have found free lactic acid in the urine of persons suffering from rickets and osteomalacia. C. Schmidt discovered lactic acid in the liquid of malacic shaft-bones which were transformed into globular cysts. Encouraged by these chemical researches, I undertook a series of experiments on the action of lactic acid, administered both by the mouth and by subcutaneous injection, upon the bones of living animals; which experiments were begun in April, 1872, and continued until the end of October, 1873. The experiments were made upon five dogs, seven cats, two rabbits, and one squirrel. On dogs and cats under one year of age the lactic acid, given either by mouth or injection, in combination with restricted administration of calcareous food, produced swelling of the epiphyses of the shaft-bones and the anterior ends of the ribs at their attachments to the costal cartilages. This result was plain in the second week after the beginning of the lactic-acid treatment. Up to the fourth and fifth weeks the swelling of the epiphyses and of the ends of the ribs kept increasing, and then was accompanied by curvatures of the bones of the extremities. As accompanying symptoms I noticed catarrhal inflammation of the conjunctiva, of the mucosa of the bronchi, the stomach, and the intestines, with emaciation and convulsive movements of the extremities. The microscopic examination of the epiphyses gave an image fully identical with that of the epiphyses of rickety children. Upon continuing the administration of the lactic acid, the swelling of the epiphyses of the shaft-bones gradually increased, and so did the curvatures of the same bones. After four or five months of lactic-acid treatment, under often-repeated catarrhal inflammations of the above-named mucous layers, the shaft-bones became soft to such a degree that they could be bent like the branches of a willow tree. After from four to eleven months of the same treatment the microscopic examination of the bones gave a result corresponding with that obtained from the bones of women who have died with osteomalacia.

"On the three herbivorous animals no swelling of the epiphyses was noticeable. One rabbit died three months and the other five months after the commencement of administration of the lactic acid, but with symptoms of inanition. No marked evidences of rachitis or malacia were traceable in the bones of these animals. The squirrel, on the contrary, which died after thirteen months of treatment with lactic acid, gave all the features of osteomalacia.

"*My experiments give the result that by continuous administration of lactic*

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[1] Heinrich Frey of Zurich.

acid, at first rickets, and afterward osteomalacia, can be artificially produced in flesh-eaters; while in herbivorous animals osteomalacia sets in without preceding symptoms of rickets. Through these experiments I have proved the identity in nature of these two diseases, the differences in their course being due to the difference in the age at which the solution of the lime-salts is established. . . . . Rickets can be produced on dogs and cats only under the age of ten or twelve months. Mr. Hess fed with lactic acid a dog of the age of one and a half years, and failed to produce rickets. This result is in full agreement with my experiments. I maintain that lactic acid, though not free in the blood, if in contact with the tissues producing bone or with fully-developed bone, owing to its great affinity for lime either prevents the formation of bone (rickets) or dissolves bone already made (osteomalacia)."

On the other hand, rachitis sometimes occurs in infants who present no history of indigestion or of intestinal catarrh, and in whom there is no ground for the belief that lactic or any other acid is produced in undue or injurious quantity. In a considerable proportion of such cases inquiry elicits the fact of antihygienic conditions, but there is no evidence of imperfect digestion or of gastro-intestinal catarrh, such as produces lactic acid. In the cases occurring in the New York Infant Asylum, alluded to above, some of the children had manifest gastro-intestinal derangement; but others, who were wet-nursed, gave no evidence of faulty digestion, though the nutriment which they received was probably insufficient; for, as already stated, by providing a more liberal diet, by allowing among other articles the juice of meat, rachitis became much less frequent, and is seldom observed at present among the infants of that institution, unless in a very mild form.

Virchow and others have suggested that the prime factor in causing rachitis is the use of a diet that is deficient in calcareous salts, and we have seen that in the interesting experiments of Dr. Heitzmann the administration of calcareous food to the animals was restricted. Still, as Niemeyer has well said, deprivation or restricted use of the chalky salts cannot possibly cause the most important histological change in rachitis—namely, the proliferation of the epiphyseal cartilages and periosteum—and we must look for some other factor in the causation.

Pathology furnishes many examples of chronic disease attended by proliferation of tissue, the causes of which are not uniform. Cirrhosis, with its proliferation of hepatic connective tissue, which, as we shall see, presents a similitude in some respects to rachitis, is sometimes undoubtedly produced by the irritating action of a chemical agent—to wit, alcohol; but all physicians know that there are many cirrhotic patients who refrain entirely from the use of alcohol in any form. In like manner, it seems to me that if we admit, as we must in the light of experiments, that certain chemical agents, notably phosphorus and lactic acid, introduced into the system or produced in it, cause rachitis by their irritating action, there are other typical cases in which there is no reason to suspect the operation of such agents. We must therefore remain in the belief that rachitis, like many other pathological processes, does not result from a fixed and uniform cause, but from conditions which vary to a certain extent in different patients. Kassowitz believes that the osseous changes which occur in rachitis result from inflammation, which occurs from different causes. Comley believes that the cause of rachitis is a chemical change in the blood which occurs from digestive disorders. Cheadle believes that all other causes are subsidiary to bad feeding. Bottle-fed infants, especially those whose diet is mainly farinaceous, he says, are especially liable to rachitis.[1] Gallois, Fournier, and Broca regard rickets as "the expression of a constitutional degeneracy, of which the causes are multiple." The proximate cause, chemical or other, Gallois thinks will be more clearly ascertained.[1]

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[1] *London Lancet*, August, 1888.

ANATOMICAL CHARACTERS OF RACHITIS.

For convenience of description the course of rachitis is divided into three periods: (1) That of proliferation and altered nutrition of cartilage and periosteum; (2) That of curvature and deformity; (3) That of reconstruction.

Anatomical Characters in the Stage of Proliferation and Altered Nutrition.—Ossification of a long bone occurs from the epiphyseal cartilages and from the periosteal or fibrous membrane which surrounds, nourishes, and protects the bone. Growth in length is from the former, in thickness from the latter. As regards the flat bone, while growth in thickness occurs from the periosteum, that in breadth is from the cartilage of its border, which corresponds with the epiphyseal cartilage of the long bone.

CARTILAGINOUS CHANGES.—If we examine the epiphyseal cartilage of a long bone during normal ossification, we observe first, beginning at the distal end, a white zone consisting of a hyaline matrix, in which are the usual cartilage-cells. This constitutes most of the cartilage. Underneath this, and nearer the bone, is the *zone of proliferation*, the cartilage in which is softer and more yielding than that of the distal zone, in consequence of cell-formation and absorption of the matrix to make way for cell-groups. Each cartilage-cell in the proliferating zone has divided into two cells, and each of these cells into two other cells, and the division has been repeated, so that eight cells instead of one are observed, surrounded by a common capsule. The capsule becomes distended by the cell-multiplication and by the swelling of each cell, the size of which is considerably greater than that of the parent cell. Near the bone—namely, along the extremity of the diaphysis—the cell-groups, enclosed in their capsules, nearly touch each other, the matrix having for the most part been absorbed. The end of the diaphysis is covered with a layer of these cell-groups about to undergo ossification, with almost no intervening matrix. The proliferating zone has very little depth. It appears to the naked eye as a very thin, scarcely perceptible, layer of a reddish-gray color upon the end of the shaft. It is so shallow that it does not perceptibly increase the thickness of the cartilage.

In rachitis the state of affairs is different. The zone of proliferation, instead of being confined to a single, or at most a double, layer of cell-groups, consists of many layers involving nearly the whole epiphyseal cartilage. The cells, still enclosed in their distended capsules, undergo a more frequent division than in health, so that instead of groups of eight cells, as in the normal state, each group consists of from thirty to forty cells. Therefore, in rachitis the proliferating cartilaginous zone is a broad cushion, very soft, of a grayish translucent appearance, causing the characteristic swelling observed around the joint. Over the distal end of the proliferating cartilage there may still be a layer or zone, though perhaps of little depth, of normal cartilage, like that in health.

OSSEOUS CHANGES.—While this occurs the ossifying process is also arrested. We indeed perceive an effort in the direction of bone-formation. The Haversian canals, surrounded by capillary loops, extend from the bone into the proliferating zone of cartilage. Their extension is effected by absorption of the matrix and appropriation of cell-groups which lie in their way. The cells in these groups as they enter the Haversian system become

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[1] *Annual of the Univer. Med. Sci.*, 1889.

much smaller by a rapid segmentation, forming medullary cells. We also find, as further evidence of the attempt at bone formation, granules and masses scattered through the cartilage, and here and there spiculæ and nodules of true bone springing up from the bony substratum of the shaft. Some of the canals extend far into the cartilage, nearly, indeed, to its free surface, but most of them terminate in its lowest portion. The growth of bone in thickness occurs from the under surface of the periosteum. In health a soft, vascular, germinal tissue springs from the periosteal surface, and rapidly receives lime-salts and is transformed into bone. This general tissue, consisting largely of capillaries arising from the fibrous tissue of the periosteum, is a very thin substratum, barely visible, transient, and constantly changing, from its conversion into bone.

In rachitis this vascular subperiosteal tissue, not undergoing or undergoing slowly and imperfectly the osseous transformation, and at the same time increasing more rapidly than in health, under the irritating influence of the rachitic disease becomes a thick layer. Its color and appearance are like spleen pulp, so that the older observers supposed there was a hemorrhagic extravasation between the periosteum and the bone. There is, however, no extravasation of blood, unless it accidentally occur from the numerous delicate capillaries. The resemblance to extravasated blood or spleen pulp is due to the abundant growth of large and thin-walled capillaries from the under surface of the periosteum, as shown by the microscope. The vascular outgrowth is, for the most part, quite uniform over the diaphyses of the long bones, while upon the cranial bones its thickness is much greater in one locality than in another. The attempt at ossification also appears in this tissue. Lime-salts are scantily and loosely deposited through it, forming osteophytes—vascular and fragile—rather than true bone.

The question naturally arises, How does rachitis affect bone which is already formed when the rachitic state begins? Virchow's answer is the following: "Rachitis has . . . . by more accurate investigation been shown to consist, not in a process of softening in the old bone, as it had previously been considered to be, but in a non-solidification of the fresh layers as they form: the old layers being consumed by the normally progressive formation of medullary cavities, and the new remaining soft, the bone becomes brittle."[1] It seems, however, from the experiments of Heitzmann, that this opinion should be modified, at least as regards rachitis produced by lactic acid. Moreover, in rachitic craniotabes occurring in infancy there is certainly bone-absorption, for portions of the occipital and parietal bones are absorbed to cause the soft spaces. We must therefore believe that there is in rachitis more or less absorption of lime-salts in the bone, in addition to that required in the normal growth of medullary cavities and canals for vessels.

In healthy bone the earthy salts are in excess of organic matter nearly in the proportion of two to one; but in rachitis the proportion is reversed, the organic matter being much in excess. The following table gives analyses of rachitic bones by Marchand, Davy, Boettger, and Friedleben:

	Femur.		Radius.		Vertebra.	
	Inorganic.	Organic.	Inorganic.	Organic.	Inorganic.	Organic.
Case I. . . .	20.60	79.40	21.24	78.76	18.68	81.32
Case II. . . .	37.80	62.20 (conval.)	20.00	80.00	32.29	67.71
Case III. . . .	20.89	79.11				
Case IV. . . .	52.85	47.15				

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[1] *Cellular Pathology*, Chance's translation, Lecture xix.

As might be expected, the relative proportion of organic and inorganic matter varies greatly in different cases and at different stages of the same case. In severe rachitis many bones are affected. It is stated that there is no bone in the entire skeleton that may not suffer, but in mild cases only a few are involved, at least to such an extent as to produce structural changes appreciable to touch or sight.

Pathology of Rachitis.

In this connection it is proper to consider the *pathology* of rachitis. What is its nature? Niemeyer, in my opinion, expresses the correct view when he says, "It seems to me that the most probable hypothesis regarding the cause of rachitis is that which refers it to inflammation of the epiphyseal cartilages and periosteum." The increased vascularity of the periosteum, the proliferation of periosteum and cartilage, the tenderness and pain on motion, and the febrile movement in acute forms of the disease, indicate inflammation rather than any other recognized pathological state. The rachitic inflammation, as it affects the osseous system, appears to be of a chronic or subacute character, presenting an analogy with certain other well-known inflammations, such as cirrhosis and certain forms of chronic nephritis, in which proliferation of connective tissue and sclerosis occur. The eburnation rather than normal ossification which terminates the rachitic process may properly be considered an osteosclerosis. Conformably with the theory of the inflammatory nature of rachitis, the periosteum is found infiltrated and thickened, and of a reddish hue from hyperæmia and from the presence of the newly-formed capillaries underneath, which have been described above as forming a layer of considerable thickness known as the "germinal vascular tissue." Moreover, as in inflammation, some secretion along with the vascular growth occurs over the bone from the under surface of the periosteum. The various interspaces in long, short, and flat bones, the diploë, cancelli, and interlamellar openings, contain a substance similar to that exuded under the periosteum. It appears to be an inflammatory exudation.

Anatomical Characters in the Stage of Deformity.—Rachitic bone, when the disease has continued for some time and is still in its active period, presents a bluish or dusky-red appearance, from its increased vascularity. After a variable time, weeks or months according to the severity of the disease, deformities begin to appear.

Spiegelberg's description of the appearance of the rachitic fœtus corresponds for the most part with what I observed in the one whose skeleton is represented in Fig. 10. According to this writer, the body and limbs are plump, the latter short and curved; the abdomen large and prominent; and the head sometimes hydrocephalic. The skin is thick and loose, and the adipose tissue well developed; the liver large; the epiphyses swollen and soft; the short and curved diaphyses sometimes broken. The rotundity of the thorax is preserved, and the sternum is not carried forward, since there has been no respiration; the ribs, in softness and liability to fracture, correspond with the long bones of the extremities. The sternum, most of all the bones, shows the delay in ossification; the clavicle is among those least affected. The cranium may be represented by a membranous bag with *plaques* of bone, or the cranial bones may be formed and in shape, but thickened and softened; the sacral promontory is pressed forward and downward; the sacral vertebræ flattened; the ilia flattened and widened; and the pubic arch increased.

It is interesting to compare these deformities with those in the child, since they occur under conditions so very different. Rachitic bone seldom retains its normal form or shape; its projecting points are rounded, and as soon as it softens it begins to yield to pressure exerted upon it. Hence the curvatures so common and characteristic. The portion of a long bone which is formed after rachitis commences contains so little earthy matter that it bends readily in its fresh state, either by muscular action or by the weight of the trunk, "in the manner," says Vogel, "of a quill or willow stick." The interior of the bone, which was formed before rachitis began, and which contains nearly or quite the normal proportion of limé, is likely to break instead of bending, but, as it is surrounded on all sides by the soft tissue, the fragments are not displaced, and probably do not crepitate. So scanty is the calcareous deposition in typical cases that, says Trousseau, "the bones . . . . can be cut with a knife with as much ease as a carrot or other soft root," and the dried specimen weighs but one-sixth to one-eighth as much as normal bone. One writer states that the dried rachitic bone is sometimes so porous, from the small amount of lime which it contains, that it is possible to respire through it as through a sponge.

In ordinary cases the bones which exhibit most strikingly the rachitic change, and which, therefore, should be carefully examined in making the diagnosis, are the cranial bones, the ribs, and the radius—the sternal ends of the ribs and the lower end of the radius. It is seldom that these bones do not give evidence of the disease if it be present, and in greater degree than other bones. They are the first to be affected to an extent that is appreciable to the observer.

CHANGES IN THE CRANIAL BONES.—In these bones interesting and important alterations occur. Their edges, which correspond with the epiphyseal cartilages, undergo proliferation and become thickened like the latter. This thickening and the delayed union of the sutures produce *grooves* which can be traced by the fingers between the bones, and which are sometimes appreciable to the sight. Rachitis causes some *enlargement* of the cranium, but the enlargement seems greater than it really is on account of the retarded growth of the facial bones. In a discussion on rachitis in the London Pathological Society, reported in the *Lancet*,[1] it was stated that in 17 rachitic children, with an average of 4.72 years, the average circumference of the head was 21.22 inches, while in the same number who were non-rachitic and with an average of 6.05 years, the average circumference was 19.95 inches.

The retarded ossification is manifested not only in the open suturès, but also in the large size and patency of the *fontanels*, which are not closed till long after the usual time. The anterior fontanel should be closed between the fifteenth and twentieth months, but in the rachitic it remains membranous till after the second year, even into the third or fourth year. Since examination of the anterior fontanel is important in determining whether or not rachitis be present, it should be borne in mind that in the normal state this space increases in size till the seventh month, when it is at its maximum, and that after the ninth month it becomes progressively smaller.

The *shape* of the rachitic head varies. In general, instead of its normal rounded form, it approaches a square shape. Another type is sometimes observed in which there is no marked angularity, but in which the antero-posterior diameter is enlarged. In the square head the forehead projects and both the frontal and parietal protuberances are unusually prominent. The sutures are depressed to a certain extent, as has already been mentioned, and the anterior, lateral, superior, and posterior surfaces of the cranium are more flattened than in health. The lambdoidal suture, which should close by the fourth month, and the sagittal, which should close by the end of the first year, have made little progress toward union when the second year begins. The undue prominence of the frontal and parietal bosses takes its origin from the exaggerated proliferation of the periosteal or fibrous covering of the bones.

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[1] *Lancet*, 1880, vol. ii. p. 1017.

CRANIOTABES.

Thinning of the cranial bones in places so that the brain lacks proper protection has long been noticed in the examination of rachitic heads, but the injury that results to the infant was overlooked till pointed out by Dr. Elsässer. Craniotabes occurs for the most part in patients under the age of one year, and a large proportion are under eight months. Its occurrence in the fœtus, as shown by a case published in the *New York Obstetrical Journal* in 1870 and by Heitzmann's case, has already been alluded to. The factors in producing this thinning are rachitic softening of the bones and pressure—pressure of the brain from within and of the pillow from without. Consequently, the portions of the cranial arch in which the thinning occurs are the posterior and lateral, the occipital bone and the posterior half of the parietal. If the infant lie chiefly on one side in its crib, on this side the craniotabes occurs, while those portions of the cranium which are not pressed upon, as the frontal bone, exhibit no thinning. The soft spots are yielding when pressed upon, and in the cadaver they are seen to be translucent when held to the light. The amount of absorption varies greatly according to the degree of rachitic softening and the amount and continuance of the pressure. There may be in some instances simple depressions, like erosions in the bone, with a continuous but thin bony layer remaining; but in other cases, such as have been particularly examined and studied by physicians, the bone-absorption is complete over areas of greater or less extent, so that the pericranium and dura mater are in contact. In examining a child for craniotabes it should be borne in mind that the margins of the bones, even when there is no thinning, but thickening from the cartilaginous proliferation, are flexible in the rachitic. The pressure must be made in a direction from the sutures, to ascertain whether craniotabes has occurred. The pressure should at first be made lightly and cautiously with the fingers, for if there be total absence of bone, unless of very little extent, deep and forcible pressure might injure the brain, for so soft and delicate an organ, covered only by the scalp and dura mater, badly tolerates pressure. If the first examination detect no soft place, the fingers may be pressed more firmly against the scalp, when, if the bone be much thinned, so that there is only a small layer of the lime-salts underneath, it will be found to yield. The sensation communicated to the fingers when there is an open space in the cranium and the dura mater and scalp are in contact has been likened to that experienced when pressing upon a fully-distended bladder. At a meeting of the London Pathological Society, reported in the *Lancet* for November 20, 1880, Dr. Lees presented statistics to show that craniotabes was one of the lesions of inherited syphilis; but whether it may result from syphilis or not, the evidence that there is a cranial softening which is strictly rachitic appears from repeated observations to be sufficient.

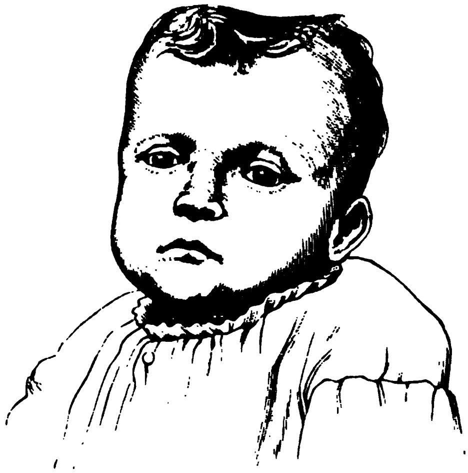
SYMPTOMS OF CRANIOTABES.—As craniotabes gives rise to peculiar symptoms quite distinct from those of the general rachitic disease, they may be properly considered in this connection. Craniotabes usually occurs during the first year of infancy, and most frequently prior to the tenth month. The brain at this age is soft and yielding, since it contains a large percentage of water. Unless handled with care at an autopsy it is readily lacerated, and moderate pressure upon it is seen to disturb and move it a considerable distance from the point of contact. It assists to a proper understanding of the symptoms of craniotabes to recall to mind the fact, well known to surgeons, that slight depression of even a small portion of the skull usually produces grave symptoms. It is not surprising, therefore, that craniotabes, when there is a space of considerable size in the cranial arch destitute of bone, is attended by symptoms due to the mechanical effect of external pressure whenever a substance less yielding than the brain comes in contact with the unprotected part.

Since pressure from the pillow without and from the brain within is believed to be the cause of the absorption, the craniotabes must obviously occur in the posterior and postero-lateral portions of the cranium. Corresponding with this explanation of the causation, the thinning actually occurs in the occipital and posterior portions of the parietal bones, while the anterior halves of the parietal bones and the frontal bones are even thicker than normal, from the cartilaginous and periosteal proliferation occurring along the sutures and on the surface of these bones, as already described. It is well known that long-continued pressure produces absorption of calcareous matter even more readily than of soft tissues, as is shown in the absorption of a tooth of the first set by the growth of the dental pulp of the second set. In the normal growth of the skull constant absorption of the under surface of the cranial bones is going on to make room for the enlarging brain, and when no calcareous deposition occurs upon the external surface to compensate for the loss within, we might expect even a greater amount of craniotabes than ordinarily occurs.

Every rachitic infant is fretful, but one with craniotabes is especially so if the open spaces be of considerable size. If it lie upon the pillow in its accustomed manner, as is most natural for it, the unprotected portion of the brain may be so pressed upon by the weight of the head that it feels uncomfortable. It does not have quiet sleep, probably because the cerebral circulation and functions are in a measure disturbed; it is apt to awaken readily and often, and frets till it is taken in the nurse's arms. Sometimes it instinctively seeks a position on the edge of the pillow with the face downward, and it becomes more quiet when resting over the nurse's shoulder with the face backward. But if fretfulness, disturbed sleep, and the necessity of closer attention on the part of the mother and nurse were the only ill-effects of craniotabes, it would possess much less pathological significance than pertains to it. Pressure upon so delicate and important an organ as the brain involves risks and produces serious symptoms in proportion to its degree. Even a slight injury of the skull which produces depression, though it may be of trifling amount, will cause serious forms of nervous disorder. So craniotabes is believed to sustain a causative relation in certain cases to one of the most dangerous of the neuroses—namely, *laryngismus stridulus*, an affection which is also designated "internal convulsions," "spasm of the glottis," and "Kopp's asthma," although Kopp was not the first to describe and recognize the malady. The etiology of this neurosis has not been fully elucidated. It is certain that a large proportion of those who suffer from it are rachitic, and that it is more common and severe where rachitis is prevalent, as in England, than where it is rare, as in the rural districts of America. It is not often the cause of death in this country, and the fatal cases that do occur are only seen in cities, whereas in parts of Europe where rachitis is much more common than with us it causes many deaths.

Certain infants when in a state of excitement have what are termed "holding-breath spells." The face is flushed and breathing ceases for some seconds, after which respiration returns and is normal. These attacks are unimportant, but they appear to be the same in nature with the more severe and dangerous seizures of laryngismus stridulus. They have no pathological significance, excepting as they show the same neuropathic state as that in laryngismus, and as they may be precursors of this disease. Laryngismus stridulus, or glottic spasm, is usually preceded by more or less impairment of the general health, and often by fretfulness, which is characteristic of the rachitic state; but the attack occurs suddenly, without premonition, and is of short duration. It begins with an arrest of respiration, a true apnœa, as if from paralysis of the respiratory centre in the medulla. The lips may be livid; a pallor spreads over the face; sometimes more or less rigidity of the limbs occurs, with carpo-pedal contractions; and after a few seconds, a quarter, or half minute a long and deep but difficult inspiration through the narrow chink of the glottis follows, accompanied in many patients by a whistling or crowing sound, and the attack ends with perhaps a momentary look of bewilderment or dread on the child's face. Now, this disease, like eclampsia, does not have a uniform causation. In certain cases it appears to be a reflex phenomenon due to an irritant in some part of the system, as in the intestines; but many observations have established the fact that rachitis also sustains a causal relation to it. A large proportion of the infants affected with laryngismus exhibit unmistakable rachitic signs, and in the opinion of many experienced observers the exposed state of the brain affords explanation of the fact that so many of the rachitic have this neurosis. Still, from observations which I have made, and from those of other observers, like Senator, it is certain that laryngismus stridulus is common in the rachitic who do not have craniotabes, so that there must be a causal relation in rachitis to laryngismus independently of the cranial softening. The accompanying woodcut represents the rachitic head of a child in the New York Infant Asylum. This patient had also attacks of laryngismus stridulus.

Fig. 11.

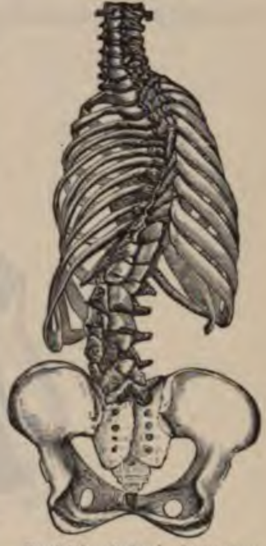


Head of a Rachitic Child in the New York Infant Asylum.

Changes in the Vertebræ, etc.—The short bones which participate in the rachitic disease become softer and more yielding, and their cancelli are filled with a reddish pulpy substance. In many rachitic cases the vertebræ are but slightly involved, so that no deformity of the spinal column results; but occasionally, when many bones are affected, the vertebræ and intervertebral cartilages soften and spinal curvatures result. The curvatures are due to the weight of the shoulders and head on the spinal column. They are, with some deviations, an exaggeration of those present in the normal state.

Rachitic curvatures of the spine are therefore mainly antero-posterior with some lateral deflections. Where there is much curvature the vertebræ become wedge-shaped, narrowed upon the concavity, and thickened upon the convexity. The intervertebral cartilages are also more or less changed by the pressure, being thinned where the vertebræ approximate to each other on the concave aspect of the curvature, and of normal thickness or thicker than normal upon the convexity. The accompanying woodcut exhibits the nature and appearance of rachitic spinal curvature in the adult. Rachitis, having occurred at the usual age, resulted in the permanent deformity here illustrated. In extreme cases, fortunately rare, the functions of important organs may be seriously impaired by the curvature and consequent compression, as in Pott's disease. Thus, according to Miller, the aorta has been so doubled upon itself as to diminish materially the flow of blood to the lower extremities and sensibly impair their nutrition. The effect of so great curvature upon the functions of the heart and lungs must obviously be detrimental.

FIG. 12.



Rachitic Spinal Curvature in an Adult. (From a specimen in the Wood Museum, Bellevue Hospital.)

At first the spinal curvatures disappear when the child reclines or is lifted by the axillæ, so as to raise the head and shoulders from the spine, but when the deformity has continued so long that the vertebræ and cartilages have become wedge-shaped, it remains for life, or can only be rectified slowly and with difficulty by mechanical appliances. As seen in the woodcut, the common curvature in the dorsal region is backward (*kyphosis*), while to compensate the patient instinctively carries the neck forward, with the head thrown back, causing cervical *lordosis*, a similar anterior curvature being common in the lumbar region. Lateral curvature (*scoliosis*) may or may not be present, even when there is considerable antero-posterior flexure. Scoliosis is sometimes produced by the nurse in carrying the infant habitually over one arm.

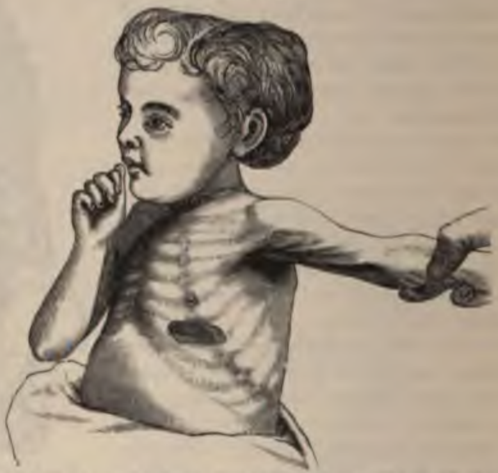
CHANGES IN THE MAXILLÆ.—Fleischmann has investigated the changes which rachitis produces in the maxillary bones. Stunted growth of the facial bones generally has long been known, and has been remarked upon by various writers; but according to Fleischmann other interesting changes occur in the jaw-bones which affect the direction and position of the teeth. According to this author, the arched shape of the lower jaw becomes polygonal, and the direction of the alveolar process also changes, so that it inclines inward. This deviation in the arch and in the alveolar process, which begins in the region of the canine teeth, necessarily causes shortening of the lower jaw. Commencing soon after, a change is observed in the upper jaw-bone from the zygomatic arch forward, so as to cause lengthening of this bone, changing here also the shape of the arch and the position of the teeth. The lateral incisors, instead of being in front, have a lateral position, and the incisors and molars diverge, so that when the jaws are closed they overlap the corresponding teeth of the lower jaw in front and upon the sides—a condition the opposite of that seen in the jaws of old people. Fleischmann attributes these changes in the lower jaw to the action of the masseter and mylo-hyoid muscles, and perhaps the genio-glossus, and to pressure of the lip, the deficiency of earthy salts in the bone rendering it more easily acted on by the muscles.

The change in the upper jaw-bone he attributes to lateral pressure of the zygomatic arches.

CHANGES IN THE RIBS.—The ribs are early affected in rachitis. The swelling of their anterior ends, where they unite with costal cartilages, producing the "rachitic rosary," has been already alluded to as one of the first and most conspicuous signs of rachitis. The costochondral articulations are enlarged in all directions, appearing as nodules under the skin. If an opportunity occur of inspecting, at an autopsy, the pleural surface, the nodular prominences are seen to be even greater and more distinct there than under the skin.

The deformity of the thorax consequent upon softening of the ribs is interesting. Commencing with the spine, the ribs extend nearly directly outward; at the union of the dorsal and lateral regions, they make a short curve forward, and then turn inward, also with a short curve toward the sternum (Fig. 14). This abrupt bending of the ribs—which, in their softened state, has been caused by atmospheric pressure during respiration—produces a depression in the thoracic wall at about the point where the ribs and their cartilages unite. A groove extends on the antero-lateral surface of the thorax from the second or third rib downward and a little outward. Sometimes the bottom of the groove is occupied by the costochondral joints; in other cases these joints are a little to one side of the deepest part of the groove. The transverse diameter, therefore, of the anterior half of the thorax is much less than in health. This necessarily diminishes the lateral expansion of the lung in inspiration and causes unusual prominence in the sternum. Hence the expressions "pigeon-breasted," "resemblance to the prow of a ship," etc., applied to this deformity. The presence of the heart renders the groove more shallow on the left side, at the fourth and fifth ribs, than on the opposite side, since this organ affords partial support to the chest-wall. On the other hand, the right groove is not as long as the left, as the lower ribs on this side are partially supported by the liver. On both sides, however, the lower part of the thorax, that below the seventh, eighth, or ninth ribs, widens, being pressed outward and supported by the abdominal

FIG. 13.



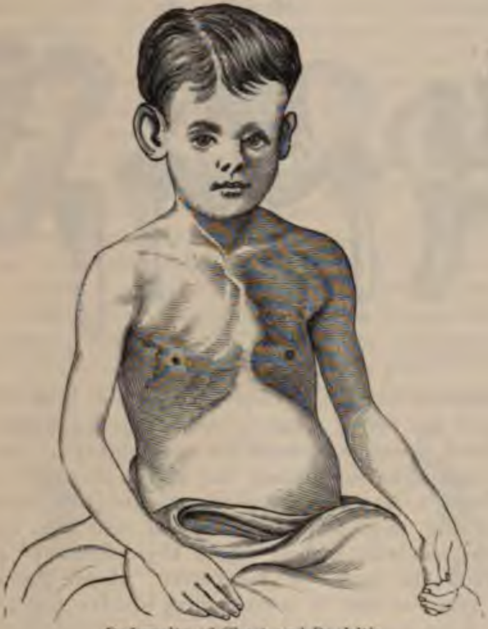
Rachitic Child with characteristic Deformity of Head, Ribs, and Radius. (From a patient in the New York Foundling Asylum.)

thorax

viscera. There is, therefore, in addition to the longitudinal groove, an antero-posterior depression, sometimes also spoken of as a furrow or groove, on either side, lying between the sixth and ninth ribs.

The ribs with their attached muscles are important agents in respiration, but the soft and yielding nature of the ribs in the rachitic retards, and to a great extent prevents, the lateral expansion of the thorax which is necessary for normal and full inspiration. The action of the respiratory muscles, and the pressure from within of the air descending along the air-passages, is not sufficient to overcome fully the external atmospheric pressure in the absence of proper resiliency of the ribs. Consequently, with each inspiration we observe more or less sinking in of the thorax on either side, just as when a moderate obstruction to the entrance of air exists in the larynx or trachea. As the ribs become firmer from the deposit of lime-salts, respiration is more regular and normal.

FIG. 14.

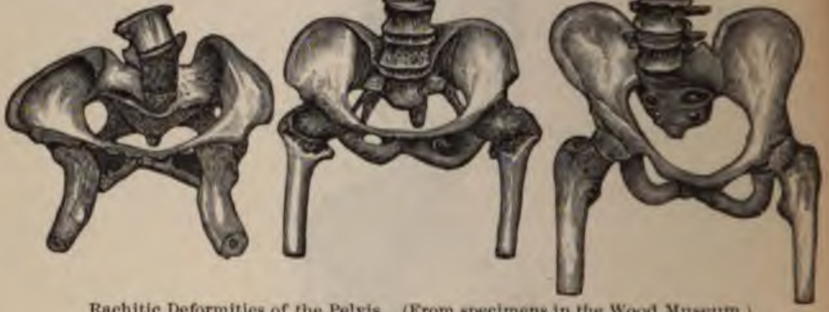


Deformity of Chest and Rachitis.

CHANGES IN BONES OF UPPER EXTREMITY.—Although swelling of the lower end of the radius (see Fig. 13) is one of the earliest signs of rachitis, the bones of the upper extremities are less frequently curved and distorted than those of the lower extremities. The *clavicle* sometimes softens and bends, producing two curvatures—one backward, near the scapula, and another of larger size nearer the sternum, directed forward and a little upward. Careful examination shows, in some rachitic patients, thickening of the margins of the *scapula*, like that of the cranial bones. The *humerus* is occasionally bent, and usually at the point of insertion of the deltoid, in consequence of the powerful action of this muscle in raising and supporting the arm. The *radius* and *ulna* are bent outward and twisted. The deformity is attributed by Sir William Jenner to the fact that rickety children support themselves, while in the sitting posture, upon the palms of the hands pressed upon the floor or couch. Supporting the weight of the body in this way not only, in his opinion, causes bending of the ulna and radius, but also aids in producing the deformities of the humerus and clavicle.

CHANGES IN BONES OF PELVIS.—The deformities of the pelvic bones resulting from rachitic softening are, in the female infant, the most important of any which the skeleton undergoes. They are produced by pressure from above of the abdominal organs, serving to widen the brim of the pelvis, and also by pressure of the spinal column, sustaining the weight of the trunk, shoulders, and head, pressing forward the promontory of the sacrum in the sitting posture, and thus diminishing the antero-posterior diameter of the pelvic brim. There is, moreover, twofold pressure from below—that caused by the heads of the thigh-bones in standing, and that exercised by the tuberosities of the ischia in sitting. Both these forms of pressure have a tendency to narrow the outlet of the pelvis. Hence the marriage of the female who has been rachitic in infancy may involve serious consequences. Many of the tedious instrumental labors in the families of the city poor, which severely tax the patience and endurance of young practitioners, are attributable to rickets in early life.

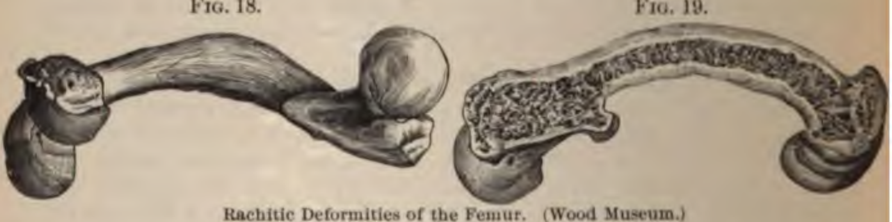
FIG. 15. FIG. 16. FIG. 17.



Rachitic Deformities of the Pelvis. (From specimens in the Wood Museum.)

CHANGES IN BONES OF LOWER EXTREMITIES.—The curvature of the *femur* is usually forward or forward and outward. The neck of the femur sometimes bends by the weight of the body or by use of the legs, so that the angle which it forms with the shaft is changed. The annexed woodcuts show the rachitic bend of this bone in an adult years after rachitis had ceased and when the bone had become consolidated by the new deposition of lime-salts.

FIG. 18. FIG. 19.



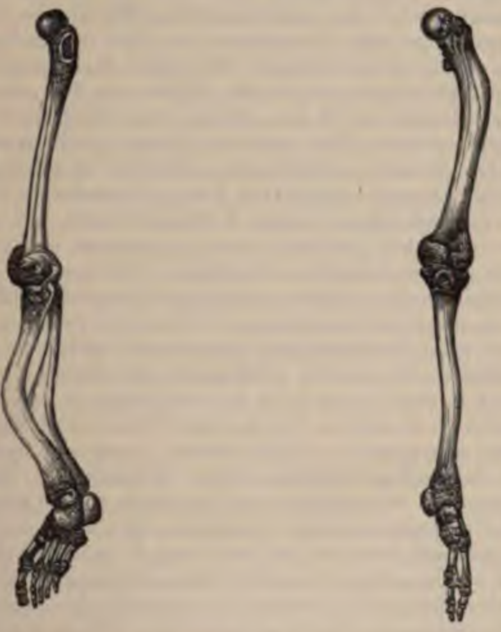
Rachitic Deformities of the Femur. (Wood Museum.)

The curvature of the *tibia* and *fibula* varies. In those under the age of one year it is frequently outward, so that the knees are separated from each other. In those old enough to stand the weight of the body usually determines also a forward bending of these bones. In one case in my practice an anterior curvature so abrupt that an angle of about 70° was formed existed about four inches above each ankle. This patient, though old enough to walk, almost constantly sat during the day with the feet extended beyond the sofa, so that the edge of the latter corresponded with the concavity of the legs. It seemed to me that the weight of the feet must have been a factor in causing these curvatures, especially as the case was one of very marked rachitic softening of different bones. Still, tibial and fibular bending at this point has been noticed by different observers, who have attributed it to the weight of the body in walking. Various other curvatures besides those mentioned occur in the bones of the lower extremities, the direction in which the limbs bend being determined by the particular circumstances of the case.

In mild cases of rickets most of the deformities described above are lacking, but in typical cases certain of them stand out prominently, so as to be readily detected by one familiar with the disease. In all such cases the diagnosis is easy beyond that of most other maladies, for the changes which occur are not only conspicuous but pathognomonic.

Rachitis produces another important effect on the skeleton. Its growth is *stunted*, not only during the rachitic period, but subsequently, so that those who have been rachitic in childhood, unless very mildly, have less than the average stature in adult life. The stunted growth is apparent, though ample allowance be made for curvatures. The arrest of development is greater in some bones than in others. It is greatest in the bones of the face, pelvis, and lower extremities. Stunted growth of the pelvic bones of the female infant, conjoined with the deformities alluded to above, may seriously affect her subsequent life, and a rachitic pelvis in the female, exhibiting both stunted growth and deformity, constitutes a valid reason for avoiding mar-

FIG. 20. FIG. 21.



Rachitic Deformities of the Femur, Tibia, and Fibula. (Wood Museum.)

riage. As a rule, the older the child is when rachitis begins the less is the skeleton affected, and the less, consequently, is the deformity.

EFFECT OF RACHITIS ON DENTITION.—As might be expected from the nature of rachitis, dentition is delayed. If the disease show itself before any tooth has appeared, the first teeth—to wit, the lower central incisors—will probably not appear before the ninth or tenth month, or even later. Sir Wm. Jenner considers the non-appearance of a tooth by the ninth month, with few exceptions, a sign of rachitis. Teeth which appear during the rachitic state are frail, deficient in enamel, and crumble readily. They become carious, rot, and break before the usual time. If certain teeth have appeared when rachitis begins, several months elapse before others cut the gum. It is even said that a child who has rachitis severely may never have a tooth, may remain toothless for life, but I have never observed such a case. Ordinarily, when the rachitic state ceases and the health is fully restored, dentition goes on as before. The arrest of teething, so easily observed, has long been considered one of the most reliable diagnostic signs. The physician cannot justly pronounce on the nature of the disease in a case of suspected rachitis unless he first carefully inspects the gums.

CHANGES IN THE SOFT TISSUES.—Although the conspicuous lesions of rickets pertain to the skeleton, the soft tissues are also more or less implicated. The *ligaments* become relaxed and flabby, giving unusual mobility to the joints and unsteadiness to the movements. The fibrous bands which unite the vertebræ, as well as the ligaments of the extremities, participate in the relaxation. In certain patients the *muscles* throughout the system—partly, perhaps, in consequence of the gastro-intestinal disturbance, indigestion, and malnutrition; partly, perhaps, for want of use (for the rachitic are usually quiet)—become shrunken and flabby. The *spleen* is frequently enlarged, as ascertained by palpation and percussion. Ritter von Rittershain found this organ decidedly enlarged in 10 out of 35 cases which he examined after death. The enlargement is the result of cellular proliferation, common in diseases which are attended by dyscrasia. The *liver* in many patients undergoes no perceptible change, except that it may be pushed a little downward. It is occasionally found enlarged from fatty infiltration, but no special significance attaches to this, for fatty liver is common in various forms of disease attended by innutrition and wasting. It is common in tuberculosis and in protracted intestinal catarrh, and its pathological significance appears to be the same in these various diseases. There can be little doubt that Sir Wm. Jenner errs when he states that albuminoid infiltration of the liver is common in rachitis. Parry, Gee, Dickinson, and Senator agree that it is rare, and that if it does occur it is by coincidence.

In a discussion on rachitis in the London Pathological Society, Dr. Dickinson[1] spoke of enlargement of the spleen, liver, and lymphatic glands which he had observed in rachitic cases. According to him, the spleen undergoes the greatest enlargement, the lymphatic glands the least, and of the latter, "the mesenteric glands show the most decided swelling." The spleen in some patients has been so large that it occupied the greater part of the left half of the abdominal cavity, but a less degree of enlargement is the rule. The liver frequently extends one or two inches below the ribs. Its enlargement, Dr. Dickinson adds, is not amyloid. "There is no new growth or deposit, only an irregular development of the proper tissues of the organs." He believes that both the corpuscular and interstitial elements are increased in the liver, spleen, and lymphatic glands. But other members of the society had observed this enlargement only in occasional cases, and they considered it due rather to the state of health which caused rachitis than to rachitis itself. Dr. C. Hilton Fagge stated that he had failed to find swelling of the liver, spleen, or lymphatic glands in a large majority of cases.[1] An undue development of the lymphatic glands from hyperplasia is very common in children in various states of ill-health, and the mesenteric glands are especially liable to become enlarged from this cause in protracted cases of intestinal catarrh or irritation.

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[1] *Lancet*, December 11, 1880.

The *abdomen* is *protuberant* from various causes. The lateral depression of the thoracic walls causes the liver and spleen to descend a little lower in the abdominal cavity than natural. The enlargement of the liver and spleen, the feeble tonicity of the intestinal muscular fibres, and consequent distension of the intestines with gas, and the rachitic shortening of the spinal column, which causes approximation of the ribs and pelvis, necessarily produce abdominal protuberance.

The *kidneys* themselves are not diseased in rickets, but there is an exaggerated discharge of phosphates in the urine, and, as stated above, lactic acid and free phosphoric acid have been found in this excretion. The urine is commonly pale; its urea and uric acid are diminished; and it sometimes contains a sediment of oxalate of lime.

The *brain* is usually well developed and appears healthy, with the normal proportion of white and gray substance. In one case the weight of this organ was ascertained by Dr. Gee to be fifty-nine ounces, and in another forty-two and a half ounces. In both brains the proportion of white and gray substances, and their color and consistence, seemed normal.

Anatomical Characters of the Third Stage, or that of Reconstruction.—This stage will be better understood if we recollect what has occurred during the first and second stages. The vascular periosteum is drawn tightly over convexities, the pressure upon which diminishes the hyperæmia and the amount of exudation underneath. Over the concavities the periosteum is loose; it is hyperæmic, with abundant new capillaries, the interspace between it and the bone being filled with the gelatiniform substance already described. The reparative process goes forward more rapidly, and the deposition of lime-salts is more abundant upon the concave surfaces, where there have been free exudation and no compression of the capillaries, than elsewhere. The lime-salts are deposited from the blood. Consequently, from the increased capillary circulation and hyperæmic state of the periosteum produced by rachitis the chalky matter is rapidly effused wherever there is an open space under the periosteum and where the capillaries are in a state of engorgement. Hence the reconstructed bone is thicker and firmer upon the concave aspect of the long bones than elsewhere, and thinnest upon the convex aspect, where the periosteum is more tense and its capillaries more or less compressed.

It is a question whether true ossification occurs at first during the reparative stage. The deposition of chalky matter is designated by some writers as a petrifaction rather than a true bone-formation. Trousseau likens it to the formation of callus after a fracture. It certainly produces a substance more compact than ordinary bone. The term "eburnation" has been applied to this new osseous formation, and I have designated it "osteo-sclerosis." Some years since I examined microscopically an adult bone which exhibited the rachitic curvature in a marked degree, and was very hard. It contained the elements of true bone, but it may have been produced after the rachitis had ceased and in the subsequent growth.

Recovery from rickets is gradual. Little by little the cartilaginous and periosteal proliferation ceases, the hyperæmia abates, and the bone-producing tissues return to their normal state. Certain of the deformities are permanent, but others disappear in the further growth of the skeleton.

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[1] *Lancet*, November 20, 1880.

SYMPTOMS OF RACHITIS.

Preceding and accompanying rachitis, symptoms may be present which are due to indigestion and intestinal catarrh, such as flatulence, unhealthy stools, and poor or capricious appetite. When rachitis begins the infant becomes fretful; its sleep is frequently restless and disturbed, and it awakens often. It repels attempts to amuse it, and is apparently annoyed by them. Nurse and mother speak of it as a cross child. It perspires freely from the head and neck both when awake and when asleep, while the extremities and trunk are dry. Its pillow is wet with perspiration during sleep, and sweat-drops may be seen upon forehead and face. If the surface be dry a little excitement or elevation of temperature causes the perspiration to appear. The rachitic child does not well tolerate the bed-clothes, and attempts to throw them off from its limbs, even in cool weather, lying exposed and causing considerable annoyance to the nurse, who strives to prevent its taking cold. Sometimes miliaria, due to the moist state of the skin, appear upon the face and neck. The subcutaneous veins which return blood from the head are large, and the jugular veins full.

Another symptom is soon observed—to wit, tenderness over a considerable part of the surface, perhaps largely due to the morbid state of the periosteum over so many bones, though it is also experienced when pressure is made upon the soft parts of the abdomen. The tenderness is probably, in part, the cause of the fretful disposition. The little patient appears to dread to be touched; its flesh is sore; it repels attempts to amuse it, and wishes to be quiet. Dandling it upon the arms, swinging it, or even walking with it, which delights the healthy child and elicits a smile of satisfaction, only adds to its discomfort. It is most at ease when left alone upon a soft cot or pillow, or, if it have craniotabes, when quietly held over the shoulder. Languor, disinclination to use the limbs or to play, moderate thirst, with other symptoms referable to the digestive apparatus which are present in many cases and which have already been described, are soon followed by changes in the skeleton which are perceptible to the sight and on palpation. The pulse and temperature, in a large proportion of the ordinary chronic cases, do not deviate from the healthy state, except that in some patients there is a slight febrile movement in the latter part of the day.

Although rachitis is ordinarily a chronic disease, insidious in its commencement, gradual and progressive in its development, occupying months, there is an acute form which is attended by more marked febrile movement and tenderness, and in which the articular swelling appears more quickly.

A *bruit de soufflet* of greater or less intensity, synchronous with the pulse, has frequently been heard in rachitic cases by applying the ear over the anterior fontanel. Drs. Whitney and Fischer, New England physicians, first called attention to this murmur, believing it to be a sign of chronic hydrocephalus. MM. Rilliet and Barthez heard it in cases of rachitis, and therefore concluded that the American physicians had confounded the two diseases. More recent observations have established the fact that this *bruit* has little diagnostic value. It is heard whenever there is sufficient patency of the anterior fontanel, both in health and disease, for sound is conducted better through a membrane than through bone. Dr. Wirthgen heard the *bruit* in 22 out of 52 children, of whom all except 4 were in good health. I have auscultated the anterior fontanel in 29 infants, who were with 2 exceptions between the ages of three and thirty months. All were well or had merely trivial ailments which did not affect the cerebral circulation. In most of them a murmur could be distinctly heard synchronous with the respiratory act, and in 15 of the 29 cases no other sound could be detected, while in the remaining 14 a *bruit* could be detected synchronous with the pulse.

COMPLICATIONS AND SEQUELÆ OF RACHITIS.

These have been in part described in the foregoing pages, but there are certain other results of the disease to which it is proper to call attention. If the deformity in the thoracic wall—namely, the lateral depression of the ribs and anterior projection of the sternum—be great, we would naturally expect that the two important organs underneath, the heart and lungs, would receive some detriment. Upon the surface of the *heart*, at the point where it supports the softened ribs, a white patch is often found, due to thickening of the pericardium and proliferation of the endothelial cells, just as thickening of the skin in the palm of the hand occurs from friction and pressure upon that part. It is probable that this pressure does not seriously impair the function of the heart, but it may increase the weakness of its movements in any asthenic disease which may occur during the rachitic period. The injury sustained by the *lungs* is greater and more apparent. If the ribs be flexible and much depressed, full inflation of the lung cannot occur in those parts where the depression is greatest. Semi-collapse of certain lobules is liable to occur, and even complete collapse of the thin edges of the lung. The stress of respiration falls unequally upon different parts of the lung. The anterior portion, which ascends with the sternum as that is propelled forward, is more fully dilated than the lateral and posterior parts, and hence is liable to become emphysematous. If in this state of the thorax and lungs severe bronchitis or broncho-pneumonia arise, the state is one of great peril. The mucus and pus, being expectorated with difficulty, clog the tubes and produce dyspnœa. Full inspiration in the lateral and depending portions of the lung, which is required in order to expel these secretions, not occurring, the result may be unfavorable, even in comparatively mild forms of inflammation. Bronchitis and broncho-pneumonia are the causes of death in not a few cases of severe rickets. Certain writers state that chronic *hydrocephalus*, *diarrhœa*, and *eclampsia* may complicate rachitis. I have not seen any case in which rickets seemed to sustain a causative relation to either hydrocephalus or diarrhœa, but we know that diarrhœa frequently precedes and accompanies rachitis, and its relation to it is that of cause rather than effect. This subject has been sufficiently treated of in preceding pages. Rachitic infants appear to be more liable to eclampsia than those who are healthy. This would be inferred from their liability to laryngismus stridulus.

DIAGNOSIS OF RACHITIS.

Rachitis in many instances continues a considerable time before its nature is suspected, the symptoms to which it gives rise being overlooked or attributed to other causes than the true one; and yet it is important that an early diagnosis be made, for it is much more amenable to treatment in its early than in its later stages. The deformities which mar the beauty, and to a certain extent impair the activity and usefulness, of so many who have been rachitic in childhood may often be prevented by early diagnosis and treatment. Many with this disease do not show the usual signs of faulty digestion and innutrition, especially on casual inspection, for there may be considerable adipose development and rotundity of features and form in a rachitic child; while, on the other hand, there are numerous instances of malnutrition and wasting without rachitis. Early diagnosis when the affection is of a mild type is necessarily difficult, but a watchful and painstaking physician will commonly detect the disease before it has run many weeks if he bear in mind its frequency and carefully examine the patient.

If called to a suspected case, we should inquire into the history, and particularly whether there have been signs of intestinal catarrh or innutrition. The gums should be inspected to ascertain whether there is backwardness in dentition, and the head to note its shape and size, whether it is elongated or whether it approximates the square shape, with broad forehead and large protuberances. We should notice also the state of the fontanels and sutures, and whether softening and thinning of the cranial bones be present. The costochondral articulations and those of the wrist should also be carefully examined to ascertain if there is any enlargement, and the shape of the thorax, which begins to exhibit the rachitic deformity at an early stage of the disease, should likewise be noticed. We should also examine the child in reference to other less prominent signs, such as spinal curvature, abdominal protuberance, muscular weakness, and relaxation of ligaments (which produce feeble and unsteady use of the limbs), perspirations upon the head and neck from slight excitement and during sleep, fretfulness, etc. If rachitis be present, certain of these signs will be observed.

The late Dr. Parry called attention to the importance of making a differential diagnosis between the *pseudo-paraplegia of rachitis* and true paraplegia, which is the prominent symptom of acute myelitis. The rachitic child, from muscular weakness and ligamentous relaxation, and from the soreness and tenderness common in this condition, may seldom use his legs—may sit or lie quietly at the age when healthy children, if awake, are constantly moving their limbs. If we attempt to make him walk or stand, his legs may be so limp and powerless that they give way under his weight; but this is a different state from paralysis. In paralysis the fault is in the nervous system—usually in the nervous centres—whereas in rachitis it is in the muscles and ligaments. The rachitic child when sitting or lying down readily moves his legs if his feet be tickled or pinched, while the paralyzed limb responds to the irritation imperfectly. In acute myelitis the loss of muscular power is, with few exceptions, confined to the muscles of the lower extremities; but in rachitis the muscular feebleness is more general, being noticeable in the arms as well as in the legs. Great relaxation of the ligaments is in most instances due to rachitis. It is especially noticeable in the ankle- and knee-joints, and is a diagnostic sign which should not be overlooked in the examination of a suspected case of the disease.

PROGNOSIS OF RACHITIS.

The prognosis of rickets is usually favorable, provided that no serious complication arises. Rachitis is not in itself fatal under ordinary circumstances. If there be much lateral depression and narrowing of the thorax, the functions of the heart and lungs may be embarrassed, and if the patient have a severe *bronchial catarrh* or *broncho-pneumonia*, the condition becomes one of danger. Rachitic children seem to be especially liable to catarrhal attacks of the air-passages, and even a moderate catarrh with a deformed thorax may prevent proper decarbonization of the blood and cause lividity and dyspnœa. Therefore, now and then a rachitic child succumbs to an attack of inflammation of the respiratory apparatus which would not have been fatal if there had been no rachitic deformity. We have seen that in whatever way it may act to produce this form of spasm, rachitis is a cause of *laryngismus stridulus*. Occasionally spasm of the glottis is fatal, but cases with such a termination are rare in America, though not infrequent in some European countries.

Of the diseases of childhood which rachitic children tolerate badly, and which may prove fatal in consequence of rachitic bone-softening and deformity, *pertussis* should be mentioned. If this be severe while the ribs are soft and yielding, and there be lateral depression of the thorax, the spasmodic cough produces great suffering and involves danger. Lividity, feeble action of the heart, pulmonary and cerebral congestion, and eclampsia may occur. *Measles*, if it be attended by considerable bronchitis, and especially if it be complicated by broncho-pneumonia, is also one of the dangerous intercurrent diseases. The gravity of these inflammations of the respiratory apparatus is usually proportionate to the degree of recession of the ribs during inspiration. With these exceptions, and with that of risk to the married female who has deformity and stunted growth of the pelvic bones, the rachitic are not liable to any ulterior serious consequences. Minor deformities in mild cases not infrequently disappear in the subsequent growth of the skeleton. The older the child is when rachitis begins, the milder is ordinarily the form of the disease, and the more speedy, consequently, the recovery, and the less the deformity. In the gravest cases the disease will almost always be found to have begun under the age of one year.

TREATMENT OF RACHITIS.

Since rachitis sometimes develops in the fœtus, it is important in order to prevent this malady that the parentage be healthy. The pregnant woman should lead a quiet and regular life, with sufficient exercise to produce healthy digestion, but without too arduous work, and with regular meals and wholesome diet. By the observance of such rules fœtal rachitis might probably in most instances be prevented. Most cases of rachitis, however, commence in infancy, so that by proper management of the infant we may hope to prevent, and usually can prevent, its occurrence.

The correct treatment of rachitis is apparent when we consider its character and the nature of its causes. The obvious indication is to restore healthy nutrition. This requires both hygienic and therapeutic measures. The apartment in which the child resides should be dry, airy, and plentifully supplied with light. He should be taken daily into the open air in order to invigorate his system, but in such a way as not to increase his suffering on account of his general tenderness. Residence in the country is far preferable to that in the city, because of the better hygienic conditions which it procures. The purer air, the better diet, and consequently the more robust development, gained by rural life are important advantages, to obtain which is abundantly worth pecuniary sacrifice when the children of a family are rachitic.

The *diet* in rachitis should receive particular attention, since indigestion and gastro-intestinal derangement sustain a causal relation to so many cases. Good breast-milk ought, if possible, to be obtained until the child has reached the age of ten months, and if the mother's condition be such that she cannot furnish it, a wet-nurse should, if practicable, be employed. But after the age of six months additional nutriment is required. As a rule, the infant should be weaned at the age of twelve months, but longer nursing may be best under certain conditions, as the presence of hot weather, an abundant supply of good breast-milk, and, on the part of the infant, feeble digestion and easily-deranged digestive organs. In case breast-milk cannot be obtained, cow's milk, properly diluted, according to the age, with water or with a farinaceous solution, is the best substitute. The reader is referred to the chapter relating to the diet of infancy for full particulars relating to infant feeding.

The milk should be sterilized by steaming in the manner mentioned in the chapter on artificial feeding, and for infants with feeble digestion it may be well to peptonize the milk. A properly-prepared farinaceous substance mixed with the milk has not only nutritive properties, but by mechanically separating the particles of casein it tends to prevent the formation of curds in the stomach. But as young infants digest starch with difficulty, it is well, I think, to employ a flour, as barley, wheat, or oatmeal, in which the starch is to a great extent converted into dextrin by the prolonged action of heat or into grape-sugar by the action of the diastase of malt, as recommended by Liebig. This flour, made into a gruel and mixed with sterilized or peptonized milk, is a suitable food for rachitic infants.

Meat soups, properly prepared according to the age, are useful additions to the diet. I have elsewhere stated that in one of the institutions of New York rachitis from being common was made to disappear almost entirely by allowing a more generous diet, a part of which was the daily use of a little beef tea. I have employed, with apparently good results, beef tea prepared as follows: Add half a pound of finely-hashed beef to one pint of cold water, mix with ten drops of dilute muriatic acid, allow it to stand cold with frequent stirring half an hour, then place it upon the table in a pail or large pan of boiling water, so as to heat it without coagulating the albumen. In an hour it is ready for use. The peptonized beef of the shops is also a useful preparation.

Medicines which improve the general health are all more or less beneficial in the treatment of rachitis, but lime and cod-liver oil are especially indicated. The following formula will be found useful in most cases:

℞. Olei morrhuæ, f℥iv;
Aq. calcis,
Syr. calcis lactophosphatis, āā. f℥ij. Misce.

Of this, one teaspoonful should be given four or five times daily to an infant of one year. This combination agrees with the digestive function, and is readily taken by most infants. Cod-liver oil, while it improves the general nutrition, is especially useful in rachitis.

Care should be taken to prevent deformities while the bones are soft and yielding. The patient should not be encouraged to stand or use the limbs until they become firmer. He should lie upon an even and soft mattress and should be taken into the open air in a carriage. A uniform support of body and limbs is requisite in order to prevent curvature.

In craniotabes the pillows should be soft, and care should be taken that the yielding parts of the cranium should not be unduly pressed upon. The perspirations may be relieved by sponging with vinegar and water. The infant should be regularly bathed in water a little cooler than the body, and rock salt may be added to the bath. The proper treatment of laryngismus stridulus, which so frequently complicates rachitis, is described in our remarks upon that disease. Constipation, common in the rachitic, should be treated by simple enemata, except so far as it can be relieved by change in the diet. When curvatures are unavoidable, orthopædic treatment will subsequently be required.

Such is an outline of the treatment which rachitis ordinarily requires, but other medicinal agents may be found useful for their general tonic action or by supplying lime-salts to the system; among which may be mentioned the compound syrup of the phosphates, the citrate of iron and quinia, wine of iron, the various preparations of cinchona, columbo, etc. Flieschmann recommends the fluorine compounds in order to increase and harden the enamel of the teeth, employing for the purpose the tooth pastille of Ehrhardt or Hunter, which contains the fluoride of potassium.

CHAPTER II.

SCROFULA.

THE term scrofula (*scrofa*, a pig, from the resemblance of the enlarged cervical glands of a scrofulous individual to a swine's neck) is applied to a diathesis which is characterized by increased vulnerability of the tissues. The nutritive process of the tissues is readily disturbed even by trifling irritants or agencies in those who have this diathesis, and therefore the scrofulous are prone to inflammations of various parts. Inflammations, which can properly be considered as dependent upon this diathesis or as occurring under its influence, are for the most part subacute or chronic, and they differ from ordinary inflammations in the fact of a greater cell-formation and greater liability to cheesy degeneration of inflammatory products, so that return to the healthy state by absorption is slow or impossible. Moreover, this diathesis, while it gives rise to certain inflammations which do not occur or are rare in other states of the system, and which all physicians at once recognize as scrofulous, often modifies those common inflammations to which all persons, whether scrofulous or non-scrofulous, are liable, as coryza and bronchitis, rendering them more protracted and less amenable to ordinary treatment.

Scrofula is a disease chiefly of infancy and childhood. Manhood, especially the first years of it, is not entirely exempt, but scrofulous manifestations after the age of twenty years are feeble and infrequent, disappearing entirely as the individual advances toward middle life. The diathesis is most active prior to the age of ten years.

CAUSES.—Scrofula is congenital or acquired. Parents who had scrofulous symptoms in early life or who are in a state of decided cachexia, as from cancer, syphilis, intermittent fever, or tuberculosis, are likely to beget scrofulous children. Insufficient nourishment of the mother during a considerable part of her gestation, and advanced age, and therefore feebleness, of the father, are occasional causes. Near blood-relationship of the parents is also a recognized cause, and to this has been attributed the scrofula of royal families. Children whose father and mother are first cousins are, according to my observations, likely to be scrofulous.

Again, those born with sound constitutions may acquire scrofula through antihygienic influences in the first years of life. Among the poor of New York we often observe one child in a family who presents scrofulous symptoms, while the rest of the children are well, and in many cases we are able to trace back the diathesis to some depressing cause or causes which were sufficient to effect the peculiar change in the molecular condition of the tissues which constitues this disease. Obviously, the causes of acquired scrofula are quite numerous. In the infant it is sometimes produced by insufficiency or poor quality of the breast-milk, or the use of artificial food during the period when breast-milk is required. Too protracted nursing at the breast also, especially if artificial food be almost wholly withheld, may cause it; as may also, in those who have been weaned, the continued use of a diet which is deficient in nutritive properties.

Residence in damp, dark, and filthy apartments or streets may also produce it. Hence one reason of its frequent occurrence among the city poor. Residence in a small, crowded, and imperfectly ventilated apartment has been known to cause it, even with personal cleanliness and a diet sufficiently nutritive.

Scrofula may also be caused, in those previously robust and of sound constitution, by disease of an exhausting nature. The eruptive fevers, as small-pox, measles, and scarlet fever, if severe, occasionally produce this result, or they render active the diathesis, which had hitherto been latent. In this city, where chronic entero-colitis of infancy is common, I have sometimes been able to trace the diathesis to the cachectic state and the impaired nutrition which it causes.

The theory has recently been promulgated that scrofula has a specific principle, and that this is a modified form of the tubercle bacillus. This theory receives some support from the fact that scrofulous glands sometimes contain the tubercular bacillus, and scrofula in many instances precedes tuberculosis. Van Merris considers the scrofulous inflammation as a local tuberculosis, and Grancher describes scrofula as a local curable tuberculosis. On the other hand, Dr. Jacobi regards the tubercle bacillus in a scrofulous disease as an "accidental invasion," and Lartigues calls attention to the fact that the tubercle bacillus cannot be discovered in most instances in the lesions of scrofula. Alexander also states that wherever we can trace the cause of scrofula, it seems to be distinct from any probable microbic agency (*Annual of the Univer. Med. Sci.*, vol. iv., 1889). Noeldechen states that the close relationship of tuberculosis to scrofula arises from the fact that scrofulous ailments afford the most favorable soil for the development of the tubercle bacillus (*Deutsche med. Zeit.*, 1887). Rabl also mentions the fact that the tubercle bacillus is often not present in scrofulous glands. He tabulates 1000 cases of scrofula, as regards their causation, as follows: 79 had scrofulous parents, 446 had tuberculous parents, 356 lived in damp dwellings, 25 were subjected to other bad hygienic surroundings, 69 could be ascribed to acute infectious diseases, 14 to vaccination, 7 to decrepitude, and 4 to consanguinity of parents (*Wien. med. Zeit.*, 1887).

Scrofula, as we have seen, results from a variety of depressing agencies affecting the system in different ways, with the general result of impairing its vigor and lowering its tone. The theory seems improbable that these many and distinct agencies cause the phenomena of scrofula through the action of a microbe peculiar to this disease.

The primary scrofulous ailments by which the diathesis is manifested occur for the most part upon one of the free surfaces—namely, upon some part of the skin or mucous membrane. Certain writers attribute this to the fact that these parts are most exposed to the action of noxious agencies. The lymphatics lying in the inflamed area take up the altered lymph and carry it to the adjacent lymphatic glands, which become irritated and undergo hyperplasia, and perhaps ultimately suppuration. This is, in a large proportion of cases, the beginning of scrofulous ailments. Nevertheless, in not a few instances the first manifestations are in deep-seated and covered parts, as when scrofulous periostitis or osteitis occurs without any peripheral lesion.

Rabl expresses the opinion that in certain cases scrofula results from syphilis in the parent or grandparent. He believes that syphilis in the parent causes scrofula in the child by diminishing the power of resistance to the causes which produce the latter affection. He thinks that in this manner parental syphilis gives rise in some children to symptoms identical with those of scrofula, while in other children it gives rise to syphilitic symptoms. The author's observations in this particular correspond with those of Rabl.

ANATOMICAL CHARACTERS.—There are no ascertained anatomical changes in the blood which are peculiar to scrofula. As long as the appetite and general health remain good and the local affections have not occurred, the composition of this fluid is, so far as known, unaltered. In the cachexia which is present when the general health is impaired the blood becomes impoverished, the red corpuscles lose a portion of their coloring matter, and the watery element predominates.

The question arises whether the glandular hyperplasia of scrofula produces an excess of white corpuscles in the blood. Virchow says: "During the progress of an attack of scrofula, in which, if the disease run a somewhat unfavorable course, the glands are destroyed by ulceration or cheesy thickening, calcification, etc., an increased introduction of corpuscles into the blood can only take place as long as the irritated gland is still, in some degree, capable of performing its functions or still continues to exist; as soon, however, as the glands are withered or destroyed the formation of lymph-cells likewise ceases, and with it the leucocytosis. In all cases, on the other hand, in which a more acute form of disturbance prevails, connected with inflammatory tumefaction of the gland, an increase of the colorless corpuscles always takes place in the blood" (*Cellul. Pathol.*). Although the glandular hyperplasia occurring in scrofula increases the number of white corpuscles in the blood, scrofula cannot be regarded as sustaining any causal relation to that great and constant increase of white corpuscles which characterizes the disease leukæmia; for this disease, as remarked by Niemeyer, does not occur in childhood, when the scrofulous diathesis is active, but in manhood, when it has ceased to exist or has become latent.

Strumous inflammations of the cutaneous and mucous surfaces, which we have seen are the initial lesions in a large proportion of scrofulous cases, do not present any peculiar anatomical elements. Some of them are attended by an abundant formation of cells and by dense infiltration of the inflamed tissues; but inflammations which do not depend on the strumous diathesis have the same anatomical elements. The most marked differences between the strumous and non-strumous inflammations are found in their origin, amount of cell-formation and inflammatory exudate, and duration.

The swelling of the lymphatic glands which is so common in the neighborhood of scrofulous inflammations, and is produced by the lodgment in the glands of irritating or noxious products of the inflammation taken up by the lymphatics and conveyed to the glands, is due to hyperplasia of the lymph-cells, with comparatively little or no increase of the stroma. Thus, hyperplasia of the cervical glands is common, resulting from eczema of the scalp or face, or from otitis or any of the forms of stomatitis; and so pharyngitis often gives rise to hyperplasia of the tonsils, which are lymphatic glands. The scrofulous nature of the glandular enlargement is apparent from the fact that it continues long after the primary inflammation which gave rise to it has abated. Lymphatic glands sometimes enlarge in those who are not scrofulous, but the tumefaction is commonly less in degree, and in most instances it soon abates when the exciting cause is removed.

The glands which commonly undergo scrofulous enlargement are the cervical, inguinal, bronchial, and mesenteric; but in those who are decidedly scrofulous the glands in the vicinity of any protracted inflammation are very prone to hyperplasia. Thus I have seen enlarged and cheesy glands in the vicinity of scrofulous osteitis or periostitis.

Under favorable circumstances the glandular enlargement abates after a short time by liquefaction and absorption of the redundant cells. But the products of hyperplastic or inflammatory action in the scrofulous individual are very liable to undergo cheesy degeneration, and the close causal relation of this cheesy substance with tubercles is now admitted. If resolution do not soon occur in the gland, it begins to undergo cheesy degeneration. It becomes firm and inelastic, its nutrient vessels narrowed and compressed, so that circulation through it ceases, and its cells, losing their liquid and vitality, shrivel away. This necrobiotic process appears in points in the gland which enlarge and unite, till finally the whole gland becomes a dead mass, with shrivelled elements of a whitish appearance, like cheese, the resemblance to which has suggested the name by which the degeneration is known.

In certain patients cheesy glands act as an irritant like inorganic matter, producing suppurative inflammation, and their subsequent history is that of an abscess. Purulent matter mixed with the cheesy débris escapes by ulceration upon the nearest surface, and scrofulous ulcers result which slowly heal, leaving permanent cicatrices; calcification of a cheesy gland occurs in exceptional instances.

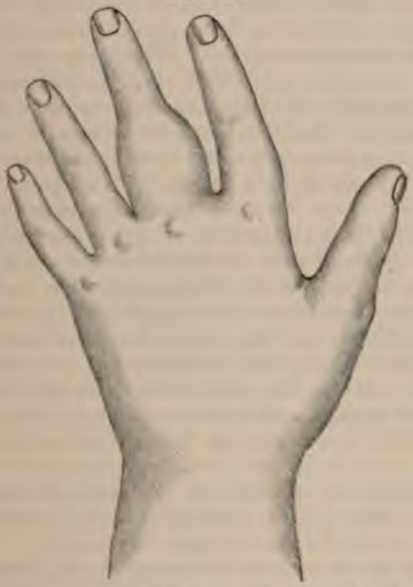
The cervical lymphatic glands in the scrofulous child, having undergone hyperplasia of their cellular elements, not infrequently continue painless and indolent for a considerable time, producing, according to their size, an unsightly appearance without undergoing cheesy degeneration. Finally, one or more become inflamed, and the broken-down gland substance softens and is expelled, mixed with pus, through an ulcerated opening in the skin.

In order to complete the description of the anatomical character of scrofula, it would be necessary to describe the various inflammations to which the diathesis gives rise. Those which are most common and important occur in the skin, mucous membrane, connective tissue, the joints, the bones with their periosteal covering, and the eye and ear. Eczema and coryza are also very common scrofulous ailments. Phlyctenular keratitis with great intolerance of light, otitis externa, causing protracted otorrhœa, or media and interna, causing deep-seated pain, with impairment or loss of hearing, offensive purulent discharge, and, in the gravest cases, caries of the mastoid cells or caries extending along the petrous portion of the temporal bone even to the brain, causing meningitis and death, are not uncommon manifestations of scrofula in the families of the city poor. Strumous cellulitis, occurring independently of the glandular affection and quickly ending in suppuration, is also common. The term *cold* is applied to the abscess when the local symptoms are slight and there is but little heat of the parts. In young children the common seat of these abscesses is directly under the skin, so that if subcutaneous cellulitis running into an abscess occur in a young child, he probably has the strumous diathesis.

The osseous system is very prone to inflammation in the scrofulous. Periostitis, osteitis, and arthritis, rare in those with healthy constitutions, are common in the scrofulous, in whom they result even from very slight injuries, and sometimes without the recollection of an injury, and apparently from the direct influence of the diathesis. These inflammations are more common in the lower extremities than in the upper. Periostitis often occurs in scrofulous children without osteitis, when its usual seat is upon the shafts of the long bones, and it also accompanies inflammations of the bone, as pleurisy accompanies pneumonia. The osseous inflammations of strumous patients are of two kinds: first, the destructive, producing caries with suppuration or necrosis; and, secondly, the so-called *fungous*, in which there is proliferation of tissue, as in white swelling. Often both these processes coexist, granulations and new tissue springing up while the carious or necrotic process is extending.

Dactylitis is in most instances, when occurring in young infants, a syphilitic affection, but in children of one year or more, in whom no marked syphilitic symptoms have previously occurred, it originates from the strumous cachexia, as in the following case: Charles R——, aged twenty months, was admitted into the New York Infant Asylum in 1876. He had always been pallid and had a strumous aspect. A physician acquainted with his parentage states positively that he is free from syphilitic taint, but when a few months old he had a mild form of coryza, which gradually abated under anti-strumous treatment. At the age of five months he had purpura hæmorrhagica of a severe form, but apparently not accompanied by hemorrhage from any of the mucous surfaces. The patches of extravasated blood were quite numerous and large over the trunk and limbs, and it was nearly three months before they entirely disappeared. A few months subsequently he began to have offensive otorrhœa on one side, which did not entirely cease. In December, 1876, at the age of eighteen months, well-marked dactylitis was first observed, involving the first phalanx of the left middle finger. The swelling was somewhat tender, and the skin which covered it had a slightly reddish or pinkish tinge, indicating the inflammatory nature of the malady. Neither joint at the extremity of the phalanx was involved, so that the movements were unimpaired. The dactylitis increased somewhat after it was first discovered, and then began to decline under treatment with cod-liver oil and syrup of iodide of iron. The accompanying woodcut represents the outlines, obtained by tracing the hand of the infant when pressed on paper.

FIG. 22.



SYMPTOMS.—The scrofulous diathesis is exhibited by certain physical signs which are present in infancy, but are more manifest in childhood. In one class of strumous children they are as follows: Form tall and slender; quickness of movement and perception; intelligence good; skin thin and semi-transparent, through which the superficial veins are distinctly seen; features delicate; cheeks habitually pallid or florid, and flushed by slight excitement; eyes bright, with bluish conjunctiva; muscles and bones slender in proportion to their length. Those children who present these peculiarities are said to have the erethitic form of the diathesis.

Others have what has been designated the torpid scrofulous habit, which is characterized by softness and flabbiness of the flesh, distended abdomen, large head, broad face, slow, languid movements, and an over-production of fat in the subcutaneous connective tissue in certain situations, especially the nose and upper lip. Though typical cases can be readily referred to one or the other of these forms, there are many which are intermediate.

One of the earliest of the scrofulous manifestations is subcutaneous cellulitis, alluded to above, giving rise to abscesses, commonly not large, with little surrounding induration, little pain, tenderness, and heat, and slow in discharging; in a word, indolent. The most frequent seat of these abscesses is upon the extremities, but they may occur upon the scalp or elsewhere. They gradually heal when the pus escapes, their site being indicated for a considerable time by the depression and reddish discoloration of the skin. Ordinarily, these abscesses do no harm apart from the reduction of the general health which they effect, but, when occurring in localities where the connective tissue lies upon the periosteum, as upon the fingers, periostitis may result, with destruction of the surface of the bone. Again, thrombi may occur in the vessels of the inflamed part, giving rise to emboli, embolismal pneumonia, and death. Specimens from such a case were presented by me to the New York Pathological Society in 1868.

The scrofulous affections of the skin often also occur at an early age, even before dentition. They are more frequent in infancy than in childhood. The most common are eczema and impetigo, and, of rare occurrence, ecthyma and lupus. But all these may occur in those who are not strumous or who do not present the characteristics of the strumous diathesis.

Scrofulous affections of the mucous surfaces are scarcely less frequent than those of the skin. They present the ordinary features of mucous inflammations of a subacute and chronic character.

Sometimes they occur without obvious exciting cause; in other cases there is a cause of this kind, such as exposure to cold; but the inflammation, once established, continues on account of the diathesis. It is often doubtful whether inflammations in strumous subjects be of such a character that it is proper to designate them strumous, especially if they occur upon such surfaces as are frequently the seat of ordinary inflammation. If the child have heretofore presented symptoms of scrofula, if the inflammation be subacute, and there be no apparent cause to originate or sustain it apart from the diathesis, it is probably of a strumous character. The diagnosis is rendered more certain by observing the effect of antistrumous remedies. The most frequent of these scrofulous inflammations of mucous surfaces are coryza, tracheo-bronchitis, and conjunctivitis. More rarely, stomatitis, pharyngitis, vaginitis, and, according to some, entero-colitis, are of a strumous character. Coryza gives rise to snuffling respiration, the formation of crusts around and within the nares, and excoriation of the upper lip. The tracheo-bronchitis is attended by thickening of the mucous membrane, increased production of mucous and epithelial cells, and a loud tracheal râle accompanying each inspiration.

Strumous inflammation of the mucous membrane of the trachea and bronchial tubes is not a very infrequent disease in this city. It sometimes originates in a simple inflammation from cold or the tracheo-bronchitis of measles or pertussis, and it may continue, with its râles, cough, and scanty expectoration, for months, unless relieved by a proper course of treatment.

Among the most common of the strumous affections are inflammation of the eyelid, designated psorophthalmia, and that of the eye itself. The former is characterized by redness and thickening of the lids, detachment of the eyelashes, and inflammation and altered secretion of the "Meibomian glands;" the latter—to wit, strumous ophthalmia—by pain, lachrymation, photophobia, and a moderate degree of hyperæmia of the affected organ. One of the most common serious results of strumous conjunctivitis and keratitis is the formation of phlyctenulæ and ulcers on the margin of the conjunctiva and upon the cornea, fed by newly-formed vessels. If not controlled by proper treatment they may result in opacities more or less permanent, or possibly, worse still, in perforation, with its consequent ill effects.

Inflammations of the external and middle ear have their origin very generally in the strumous diathesis. Occasionally there is an exciting cause of the otitis, as an injury or severe constitutional disease, like scarlet fever. Protracted otitis, whether external or internal, and especially that form of it which leads to ulceration, destruction of the ossicles, and caries of the petrous portion of the temporal bone, it is proper in a large proportion of cases to regard and treat as strumous.

The stubbornness and frequent disastrous consequences of scrofulous inflammation of the bones are well known. Nearly every bone, as well as its periosteum, is liable to this form of inflammation, but some are more frequently affected than others. Inflammation of the bone may terminate by resolution, by the formation of an abscess, or (and frequently) by carious or necrotic destruction of the bone itself. Necrosis most frequently occurs in the shafts of the long bones; caries in the spongy extremities of these bones and in the spongy portions of the short bones. If abscesses form, the pus may finally escape from the system by a tedious ulcerative process, or, retained, may undergo cheesy degeneration. Scrofulous arthritis, if early detected and properly treated, may resolve, leaving no ill effect; if otherwise, suppuration, ulceration, cartilaginous and osseous, and ankylosis often occur.

Scrofulous children are perhaps no more liable to inflammation of the internal organs than other children, but the inflammatory products are more liable to cheesy degeneration, and the prognosis is therefore less favorable. The most frequent of these inflammations and the one of chief interest is pneumonia. Catarrhal pneumonia, so frequent in early life, whether primary or secondary, in connection with measles, pertussis, etc., is a disease often involving grave consequences in those who are decidedly scrofulous, since, instead of resolving, the affected lung-tissue presents a strong tendency to caseous degeneration, ending in tuberculosis of the lungs and death. I have most frequently noticed cheesy pneumonia during extensive epidemics of measles as a complication or sequel of this disease. It may occur in those who are not scrofulous if the vital powers be greatly reduced, but it is so much more common in the scrofulous that some recent writers have designated this form of inflammation by the term of scrofulous instead of cheesy pneumonia. From the fact, however, of its sometimes occurring in the non-scrofulous, the term cheesy or caseous—especially, too, as it expresses the anatomical state—seems more appropriate.

The caseous substance which results from degeneration of the products of scrofulous inflammations affords a nidus in which the tubercle bacillus frequently obtains lodgment and conditions favorable for its propagation. Hence the close etiological relations of scrofula or scrofulous inflammations to tuberculosis.

PROGNOSIS.—As scrofula may be acquired through antihygienic influences, so it may disappear or become latent through influences of an opposite character. Therefore the manifestations of scrofula may be limited to a brief period, or they may occur at intervals through the whole of childhood and the first years of youth. When the diathesis is inherited and fostered by unfavorable circumstances, the scrofulous affections appear earliest, are most varied and severe, and continue longest.

In most cases, with proper treatment, the prognosis is good, but the danger to life depends on the nature and extent of the scrofulous inflammation. The most common unfavorable result is the occurrence of pulmonary or general tuberculosis, the caseous substance, as we have said, affording a favorable nidus for the development and propagation of the tubercle bacillus. This is the usual result in cheesy pneumonia. The next most common cause of death, either directly or indirectly, is inflammation of the osseous system. Many deaths occur from inflammation of the vertebræ or of the hip or knee-joint when it has been allowed to continue a considerable time without proper treatment. Protracted suppurative inflammation of the bones is liable to produce amyloid degeneration of organs, which is permanent and likely to prove fatal, or death may occur from exhaustion, with or without tuberculosis. Among the city poor meningitis is not very uncommon, consequent on long-continued otitis media and caries of the petrous portion of the temporal bone. Permanent impairment of sight and hearing often results from neglected strumous ophthalmia and otitis.

At puberty the strumous affections gradually become less frequent, and they finally disappear in advancing age. Among the most robust adults are some who in early life presented indubitable symptoms of the strumous diathesis.

TREATMENT.—*Prophylactic.*—Measures designed to prevent scrofula are impossible without the co-operation of willing and intelligent parents. It is obvious that the prevention of congenital scrofula requires the treatment of disease or impaired health in the parent. If parents should be taught or should remember that good health in themselves is the necessary condition of the inheritance of a sound constitution in the child, and would adopt such therapeutic and regimenal measures as would procure this, the number of cases of inherited scrofula would be materially reduced.

As the first years of life are very important, both for correcting the diathesis when inherited and for preventing its development in those of sound constitution, care should be taken that the regimen of the child be such that it does not cause deterioration of the general health. The nursing infant, if the mother be in poor health, should be provided with a healthy wet-nurse, for in young children the diathesis may be acquired solely by the use of food that is scanty or of poor quality. Those old enough to be weaned should have plain and nutritious diet, with a proper admixture of animal food. More or less outdoor exercise and residence in a salubrious locality, with sufficient air and sunlight, are also requisite.

Curative.—Since scrofula originates in a state of weakness existing in the parent in the congenital, and in the child in the acquired, form of the disease, and is characterized by feeble resistance of the tissues to irritating agents, the inference is reasonable that all tonics have, to a certain extent, an anti-scrofulous effect upon the system. The ordinary vegetable tonics, and sometimes the ferruginous, are indeed useful in the treatment of scrofula. Employed in connection with proper regimenal measures, they are sufficient, in many cases, to remove the diathesis after a time or render it latent. Besides these medicinal agents, which tend to correct the scrofulous diathesis by their general tonic effect, there are certain others which experience has shown to be beneficial in the treatment of scrofulous affections, and which are therefore largely used. One of these is cod-liver oil, which contains iodine among its many ingredients.

Cod-liver oil is useless or nearly so in the torpid form of the diathesis.

which is characterized by an increased deposit of fat in the subcutaneous connective tissue, slow circulation, and sluggish muscular movements. On the other hand, in the treatment of the erethitic form it possesses real value. Its protracted use in such cases does so modify the molecular condition of the tissues that they are less liable to inflammation, and the diathesis is therefore rendered milder or removed. From one to three teaspoonfuls, according to the age, should be given three times daily. While we frequently experience so much difficulty in administering it to adults affected with tuberculosis, and sometimes find it necessary to discontinue its use on account of its nauseating effect, scrofulous children rarely refuse to take it, and it does not seem to diminish their appetite.

Iodine is justly celebrated as a remedy in the treatment of scrofulous maladies, but it is a question whether it has not been overrated as a remedy for the diathesis itself. Iodine employed internally is especially serviceable in glandular hyperplasia and in scrofulous thickening and induration of the connective tissue and periosteum. In general, it should not be administered to children in its isolated state, on account of its irritating properties, but one of its compounds should be employed. The compounds which are chiefly prescribed in the treatment of scrofula are the iodides of starch, iron, potassium, and sodium. If, as is frequently the case, the patient be pallid and his appetite poor, the iodide of iron should be preferred; if not in this cachectic state the iodide of starch may be used. Pharmaceutists prepare syrups of both these iodides, so that they can be readily administered to the youngest child. The iodide of starch may be administered by dropping from one to five drops of the officinal tincture of iodine on a little powdered starch and giving it in syrup. These iodides are preferable to the iodides of potassium and sodium for internal administration to children, since they are not irritating to the mucous membrane and the iodine is readily set free. Prof. Dalton has, indeed, demonstrated that the iodide of starch is decomposed in most of the liquids of the body and the iodine liberated.

In New York City a large proportion of the scrofulous children are cachectic and need iron, and the iodide of iron is more frequently employed, and with good results, than any other iodine compound. The syrup of the iodide of iron, which is readily absorbed, should be given in one- to two-drop doses three times daily to a child of six months, and one additional drop be added for each additional year. Among the vaunted remedies of scrofula are phosphoric acid and the phosphate of lime. I have not employed these agents without at the same time using other remedies, and cannot say, therefore, to what extent they have been curative in my practice. Probably there is no better combination of remedies for the strumous diathesis than the following, which is now used in some of the institutions of New York, and which we have already recommended in the treatment of rachitis:

℞. Ol. morrhuæ,	2 parts;	
Syr. calcis lactophosphat.,	1 part;	
Aquæ calcis,	1 part.	Misce.

Dose: One teaspoonful to a dessertspoonful three or four times daily. The syrup of the iodide of iron should be given at the same time in three daily doses, but not mixed with the above preparation of oil and lime, as a double decomposition occurs from the admixture.

The internal use of mercury as an antidote for scrofula is now generally discarded. Unless, perhaps, in those cases in which the diathesis is immediately dependent on syphilis, its use for this purpose, from what we know of its therapeutic effects, would probably be more injurious than beneficial.

Among the medicines which have from time to time been employed for the cure of scrofula, some of which have had considerable reputation, but have nearly fallen into disuse, are walnut-leaves, sarsaparilla, elecampane, conium, digitalis, horseradish, compounds of silver, gold, arsenic, baryta, and bromine. It is probable that none of these has any effect on scrofula or scrofulous ailments except such as improve the appetite and general health, as horseradish.

The same hygienic measures are required in the treatment of scrofula as are employed in the prophylaxis of it. The nursing infant should have healthy breast-milk, and if its mother belong to a tubercular or scrofulous family or be feeble, a healthy wet-nurse should be employed, or it should be sent to the country, where suitable cow's milk as well as pure air can be obtained. The expressed juice of beef slightly boiled, the peptonized beef or beef tea prepared as recommended for rachitic infants, given several times daily in small quantity to infants, aid materially in restoring a better nutrition of the tissues. Obviously, similar care is necessary in the selection and preparation of the food of children who have passed beyond the period of infancy. While the diet should be highly nutritious, it should be plain and easily digested, and given at sufficient intervals, so as not to overtax digestion. The cow's milk employed should be of the best quality, and for young children it may be best to peptonize it.

Fresh air, outdoor exercise, daily bathing, personal and domiciliary cleanliness, are very necessary for the successful treatment of the diathesis. Since scrofula is comparatively infrequent in farming sections, scrofulous families are greatly benefited by farm-life, with all the accessories to health which pertain to it. The use of sea-air and sea-bathing has, according to the testimony of several observers, been very efficacious. Dr. F. P. Henry states that no other remedial measure is so efficacious as these (*Annual of Univer. Med. Sci.*, 1889). Dr. Valcourt, who is in charge of the Maritime Hospital at Cannes, where scrofulous children receive daily sea-baths during a considerable part of the year, read an interesting paper in commendation of its use before the Pædiatric Section of the Ninth International Medical Congress in 1887. Alexander quotes the statistics prepared by Cazin, which show that the mortality of scrofulous children is much less in the hospital at Barck, where sea-bathing is employed, than in two Parisian hospitals (*Liverp. Medico-Chir. Jour.*, 1888.)

The local scrofulous ailments require additional and special treatment. Those located on the cutaneous and mucous surfaces are less dangerous, as a rule, than the deeper-seated inflammations; still, they should be promptly treated, not only for the inconvenience and annoyance which they cause, but because they may give rise to hyperplasia of the neighboring glands, as we have stated elsewhere. Thus, pharyngitis may cause a peripharyngeal adenitis and abscess, and a bronchitis may cause adenitis of the bronchial glands, with the probability of their cheesy degeneration. The so-called bronchial phthisis is believed to result, in a large proportion of cases, from a strumous bronchitis which has been allowed to continue uncontrolled by medicine, and a similar state of the mesenteric glands may result from intestinal catarrh. Inflammation of the skin or mucous surface occurring in the strumous requires the continued use of antistrumous remedies, conjoined with such treatment, designed to act locally, as is appropriate for the case.

It is the common practice to treat the enlarged glands of struma by daily applications over them of the stronger iodine preparations. This treatment does not cause absorption of the redundant gland-substance. It causes proliferation of the epidermic cells, and quickens the cell-change in the adjacent gland and accelerates suppurative inflammation. I once produced accidentally such an amount of vesication over an enlarged, hard, and apparently indolent gland in an infant of fourteen months that I was very anxious lest a sore should result which would heal with difficulty, and yet, instead of dispersion of the glandular swelling, the pathological processes were so promoted that suppuration and discharge of pus occurred by the time that the cuticle had re-formed.

We know no better substance for the local treatment of strumous adenitis than iodine, and it should be applied, in my opinion, in such a manner that it is absorbed with the least possible irritation of the gland. The following will be found useful ointments and solutions for the treatment of these cases:

℞. Potas. iodidi, ʒj;
Ung. stramonii, ℥j.

To be rubbed over the gland several times daily. It should not be applied as a plaster, since it is too irritating and will vesicate. I have known a glandular swelling which had continued about three months to disappear in three weeks under its use in connection with internal remedies. Lanolin may be employed in place of the stramonium ointment, inasmuch as it is believed to be more readily absorbed than most oleaginous substances. Another useful iodine mixture for these cases is the following:

℞. Liq. iodinii composita,
Glycerinæ, equal parts.

To be applied as an inunction. Glycerin renders the skin soft and in a state favorable for absorption.

In *The Medical Press and Circular* for August 3, 1870, J. Waring Curran states that he has used with great success what he designates a new iodine paint, consisting of half an ounce of iodine, the same quantity of iodide of ammonium, twenty ounces of rectified spirits, and four ounces of glycerin.

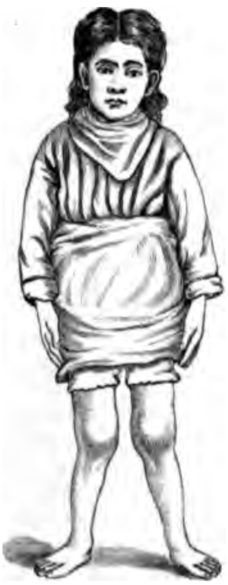
Mercurial ointments have been recommended by writers of reputation for the treatment of these glands. I have employed them and known them to be employed, but cannot say that I have ever observed any benefit whatever from their use. In the children's class at the Out-door Department at Bellevue we have discarded them entirely for this purpose, although both the citrine and white precipitate ointments, diluted with an equal quantity of lard, have been used with apparent benefit for chronic coryza of a strumous nature, and also occasionally for external otitis of the same nature.

In a paper read at the meeting of the British Medical Association in 1870 by Mr. Jordan, the writer recommends, as attended with success, vesication, not over the gland, but at a little distance from it—as, for example, behind the neck—for treatment of the cervical glands. But a mode of treatment which seems so unlikely to be beneficial requires stronger proof of its utility than has yet been presented.

The application of cold over an inflamed lymphatic gland and the adjacent inflamed connective tissue is a useful adjuvant to the treatment in many cases at an early stage. A small India-rubber bag containing ice, or muslin frequently wrung out of ice-water and applied over the inflamed parts, contracts the vessels, diminishes the activity of the morbid process going on underneath, and aids materially in the resolution. When the gland becomes so actively inflamed or the inflammation so advanced that redness of the skin occurs, applications of iodine are no longer proper. They increase the local disease. There is no longer any probability of resolution of the gland, and poultices should be applied.

It is important that the diseases of the osseous system should receive early treatment, but, unfortunately, it is in reference to these inflammations that error of diagnosis is frequently made. Thus I have known periostitis, with the diffused redness of the skin and heat which it produces, to be mistaken for erysipelas, until the diagnosis was corrected from its persistence and non-extension. It is remarkable that strumous arthritis sometimes appears in two or more joints at once, as in the case related below. I have known it to occur nearly simultaneously in three joints, though only for a brief time in two of the joints, while it was chronic in the other. Hence, the fact that this inflammation is often mistaken for inflammatory rheumatism, and treated as such for some days till its nature becomes apparent, and in like manner the febrile movement, lassitude, abdominal pain, etc. of vertebral caries are in a large proportion of cases attributed to something else, and the true disease not suspected till irreparable damage has occurred, or much longer confinement and treatment required than would have been necessary with an earlier diagnosis.

FIG. 23.



The common strumous inflammations of the osseous system which involve the joints, as Pott's disease, hip disease, and white swelling, are usually quite amenable to treatment, early applied, which ensures complete rest; but, as a rule, cases neglected or wrongly treated go from bad to worse. There are exceptions, for a case may do well or terminate with moderate deformity without treatment, as in the following interesting instance, which also shows the difficulty which often attends diagnosis:

Anna D——, aged six years, came to the children's class in the Out-door Department at Bellevue in February, 1877, with the following history: Her health was good till two years ago, when she complained of pain of a mild form in both knees. Her parents attributed it to her rapid growth, and she was always able to walk with little suffering. Slowly but steadily these joints began to swell. She has had no pain in other joints, and no member of the family has had rheumatism except a grandparent. She walks without complaint to the rooms of the Bureau. The affected joints are about equally swollen, and it is evident on examination that they contain some serous effusion. Direct pressure is not painful, but pressing the bones together with a twisting or rotating movement gives some pain. She is pale and has a strumous aspect. A sister of fifteen years has a similar swelling of one knee which began at the age of seven or eight years, but which has received no regular treatment, has not prevented the free use of the limb, and has given her little inconvenience.

The physicians who have examined this child, one of whom is an expert in orthopædic surgery, agree that the disease is strumous and not rheumatic, and that it did not, during two years of neglect and unrestrained motion, go on to suppuration and destruction of the joints was probably due to her good general health.

Though the result in the above case was good, since there was little impairment in the use of the joints and no suffering, yet delay and neglect in the treatment of those strumous inflammations which involve the joints are exceedingly dangerous, for if left to themselves they most frequently end in suppurative inflammation and ulceration, with all the sad consequences which these entail. Strumous inflammations of the osseous system now receive more early and correct treatment than formerly, and orthopædia, almost unknown till within the last twenty years, has become an important branch of surgery. Formerly in New York, especially in the tenement-houses, we often met emaciated bed-ridden children with strumous osteitis and arthritis, their limbs swollen and painful in motion, and offensive from the discharge, for the most part shunned by physicians, and with no prospect of relief except by amputation. Now this spectacle is comparatively infrequent. The early symptoms of these diseases being better understood and sooner recognized, the plaster-of-Paris or starch dressing to ensure immobility, or ingeniously devised steel splints which produce extension and allow motion of the limb without friction of the inflamed surfaces, coming into general use, a large proportion of cases do not go beyond the first stage and are cured.

STRUMOUS OPHTHALMIA.

[Written by Dr. O. D. POMEROY, Surgeon to the Manhattan Eye and Ear Hospital.]

Strumous ophthalmia in young children, as described by the older writers, is simply a keratitis or inflammation of the cornea, and is usually of the following varieties: phlyctenular or herpetic keratitis and diffuse or parenchymatous keratitis. Perhaps it is a misnomer to designate these affections strumous. This general principle governs most cases of these inflammations—to wit, depressed vital energy, which is a prominent characteristic of the strumous diathesis. As is well known, the cornea is a tissue of low vitality, and any constitutional state accompanied by depression predisposes to an attack of keratitis. One of the commonest hospital experiences is to see a mild case of catarrhal conjunctivitis which should be self-limiting gradually extend to the cornea, causing an ulcerative keratitis. I believe all ophthalmic surgeons hold that the presence of corneal disease, not dependent on an obvious or specific cause, points to diminished vitality on the part of the patient.

Herpetic or Phlyctenular Keratitis is the most frequent variety of corneal disease in children. It is a question whether it commences with a vesicle on the cornea or a papule; but in either case it soon becomes an ulcer. Ciliary injection probably precedes it, although this can by no means be always observed. In some patients the characteristic symptom—to wit, photophobia—may exist for a long time without injection of the eyeball or any corneal changes whatever, but sooner or later it is probable that other characteristic signs of the disease will make their appearance. The photophobia is frequently accompanied by blepharospasm, making it wellnigh impossible to separate the eyelids. When, however, this is accomplished, abundant tears gush forth, the child exhibiting signs of extreme distress. When the vesicle or papule is in a state of ulceration in the earlier stage, there may only be seen a minute loss of corneal tissue, without any opacity whatever. Soon, however, the ulcer becomes more or less opaque, perhaps seeming to be only a minute whitish spot on the cornea. This usually shows the commencement of reparative action. If the disease continue long, a general conjunctivitis sets in, more especially of the ocular conjunctiva. Frequently there will be only one or not more than two or three ulcers, but in exceptional cases the cornea may have the periphery studded with phlyctenulæ, which, instead of promptly healing, proliferate so as to form elevated nodules, the so-called "scrofulous nodular bands." If the ulcers in any case continue long, a number of blood-vessels shoot out from the conjunctival border of the cornea, quite up to the ulcer, producing what may be termed *a vascular keratitis*. The discharge from the eye is often very acrid, causing catarrh of the lachrymal canals, and even of the nares. Herpetic or eczematous eruptions on the cheeks or the lip near the nostrils are often seen, and may sometimes appear to be the cause of the disease rather than the effect. In this condition the upper lip may swell considerably, giving the patient a very "strumous" appearance.

The DURATION of phlyctenular keratitis is exceedingly variable; two or three weeks may bring it to a close or it may continue many months. The patient's general condition probably determines its duration as much as any other factor. If an ulcer perforate the cornea, staphyloma and anterior synechia may result, rendering recovery more tedious and incomplete. The DIAGNOSIS of this malady is not difficult. The photophobia so characteristic of keratitis is present in no other disease except iritis, and this disease children rarely have; the little speck, spot, or abrasion on the cornea, together with the intolerance of light, is wellnigh diagnostic. Photophobia is present in most forms of corneal disease, though not in all. The CAUSES of phlyctenular keratitis are as follows: Any condition of the system known as strumous, or whatever tends to lower the vital powers of the patient, affords a predisposing cause. Exposure to cold or sudden change of temperature is the common exciting cause, leaving out of the question any cutaneous diseases. Naturally, any cause which produces a conjunctivitis may also produce this disease secondarily. The process of dentition may have something to do with the eye disturbance, or any disorder of the intestinal canal; the latter, however, being rather predisposing than exciting causes. This disease also frequently occurs in patients affected with aural or nasal catarrh, but the condition of such children trenches closely on the state designated "strumous."

The PROGNOSIS in a large number of cases is very favorable. The opacities of the cornea left after the healing of the ulcerations are the principal difficulties in the way of a good recovery. If the opacities are in the proper substance of the cornea, we are not certain that they will disappear by absorption, though they may. Nothing is more difficult than to determine this point. In the epithelial and Bowman's layers, as well as the posterior layer, opacities readily disappear. When the ulcer perforates the cornea we have an anterior synechia and the appearance known as *myocephalon*, which usually disfigures the eye more or less for life.

One discouraging point about these opacities is that, although they disappear, the cornea is left with a somewhat distorted curvature, causing irregular astigmatism, and if they chance to be near the centre of the cornea great disturbance to vision results. I have often, in fitting spectacles, noticed that the patient's vision was less than normal, and on investigation have found a history of an infantile keratitis which had done all the mischief. In those cases described as having "scrofulous nodular bands" the proliferative nodules are very likely to undergo a variety of degenerations which do not end in a properly restored cornea. One great difficulty in making an exact statement here is the tendency of the keratitis to recur, and it cannot be determined where the process will cease after a number of recurrences.

TREATMENT.—As the fifth nerve presides over the ciliary vaso-motory system of the corneal nutritive supply, it is obvious that treatment calculated to correct any of its morbid manifestations would be rational. Such is found to be the fact. Sulphate of atropia, in solution of one to two grains to the ounce, dropped into the eye three times daily, is probably superior to any other treatment. It inclines to break up the orbicular spasms, relieving the photophobia and ciliary neuralgia, diminishes vascularity, and [illegible] more to the relief of the patient than any other one remedy be severe, the atropine may be used six or eight times daily, or it may be even instilled every fifteen or twenty minutes until pain is relieved. If an over-effect be reached, the patient complains of dryness in the throat, possibly pain in the head, or he may have other cerebral disturbances, when the drops may be discontinued for a time. Muriate of pilocarpine in two-grain solutions may be used in a similar manner and for the same purpose; but it contracts the pupil and renders the accommodation tense, the very opposite to the atropine effect. I have not as much confidence in this remedy. A 2 per cent. solution of cocaine, instilled, will sometimes relieve the spasm and pain temporarily. Powdered calomel may be dusted into the eye every second day. A small quantity only should be used, since it is apt to collect in masses which act as foreign bodies (we desire to produce irritation for a few minutes only). A drachm of table-salt to a pint of water may be used to bathe the eyes freely four or five times a day, used warm or cold according to the patient's pleasure, although warm applications are more likely to be well received. Red precipitate ointment (℞. Vaseline, ʒj; hyd. ox. rub. in very fine powder, gr. j to ij. M.) placed under the eyelids every day or two, is often very beneficial; also the yellow precipitate ointment, made in the same manner, has a similar effect. Occasionally the ulcers show a disinclination to heal, when they may be touched with Arg. nit., gr. x to xxx; aquæ dist., ℥j. M. Wind a bit of absorbent cotton on a probe, dip this into the solution, and touch the ulcer, but no other point. Cupri sulph., in solution of the same strength, may be used for the same purpose. A platinum probe, heated to a red heat in a spirit lamp, is much used at present. A few drops of a 2 per cent. solution of cocaine, previously instilled, will prevent pain from these applications. A protective bandage exerting moderate pressure on the eye sometimes does good, but it should not feel uncomfortable. If there be much spasm of the orbicularis, however, it is not indicated. If the pain in the eye continue and the orbicularis be in a state of spasm, cantholysis may be performed; that is, divide the external canthus so as to cause the lid no longer to press hard upon the eyeball, and close the wound thus made by stitching the skin to the conjunctiva above and below the incision, and placing one stitch in the extreme outer canthus. The result of the operation is temporarily to break the power of the orbicularis, so as to arrest the spasm. This measure accomplishes in some cases what nothing else will.

If the eye be painful, without spasm of the lid, and there be great photophobia, whether the eyeball be too hard or not, paracentesis may be done. The mode of performance is described in the treatment of ophthalmia neonati in another place in this book. After a while the accompanying conjunctivitis may need treatment in the ordinary way. Indeed, astringents may often be used quite early to obviate the irritating effects which occasionally result from the use of atropine. If an ulcer refuse to heal after the treatment already laid down, iridectomy may be performed, although this is not often resorted to. Occasionally an ulcer may be cut across by passing a narrow Graefe's knife through it, making a puncture on one side and a counter-puncture on the opposite side, and then cutting out quite through the ulcer, dividing it into two equal parts. All needful treatment for the constitutional condition of the patient should be attended to. So necessary are fresh air and sunlight that I would never shut the patient in a dark room. Blue or smoke-colored glasses may be worn to protect the eyes from a strong light, and in some cases the eyes may be protected by a bandage of some dark material, so that the patient may be taken for an airing without suffering. I would, however, advise to accustom the eyes to the light as much as possible without causing pain.

In **Parenchymatous** or **Diffuse Keratitis** we have quite a different array of symptoms. The margin of the cornea near the limbus may show a decided zone of injection of the conjunctival and episcleral vessels. It may be so excessive as to consist apparently of a rosy ring surrounding the cornea. These vessels after a time shoot inward, and may involve a large part or even the whole of the cornea. In other cases, designated *non-vascular diffuse keratitis*, the injection is very slight indeed, and sometimes apparently wanting altogether. In either case, however, the same consequences result: the cornea becomes diffusely clouded, the process generally, but not always, commencing at the limbus. This cloudiness may be quite without lines or dots of opacity, like ground glass. Again it may appear composed of innumerable minute opaque points or lines running in various directions. At first, the corneal epithelium escapes, presenting a regular and uniform polish, but afterward it becomes opaque. Again, if the process involve the whole of the cornea, minute opaque spots may be seen in Descemet's membrane, giving it some of the characteristics of keratitis punctata. In the earlier stages there may be some pain and intolerance of light, but as a rule the disease, for a corneal affection, is comparatively painless. The DURATION of this disease is never short; it may continue for many months, and it shows a strong tendency to relapse. The most frequent CAUSES are hereditary syphilis and struma. Mr. Hutchinson of London always examines the teeth of these patients to see if there be anything characteristic of hereditary syphilis. As similar teeth are often noticed in strongly-marked strumous subjects, it becomes doubly interesting to make the observation. One point is apparent in most of these cases: that there are in almost every patient some signs of badly-developed physique—that is, faulty tissue-elaboration. As a rule, both eyes sooner or later become affected, pointing to a constitutional origin of the affection.

In TREATMENT we are often disappointed in our efforts. At the first, if there be pain or photophobia, atropine may be instilled and the eyes bathed with warm or tepid water several times a day. Tonics or alteratives are always indicated. One of the most useful prescriptions is the following:

℞. Hydrarg. chlor. corros., gr. j., ad jss;
Tinc. cinchon. comp.,
Syr. aurantii, āā. ℥iv. Misce.
Dose: One teaspoonful three times daily after eating.

Iodide of potassium is frequently given, and may very properly alternate with the mercurial; children will bear very large doses of the iodide, and indeed they are often necessary in order to obtain the curative effects of the drug; I would suggest from three to twenty grains three times daily, well diluted with water. Both these remedies may be continued for months, but ptyalism should always be avoided. Cod-liver oil with extract of malt may be administered. Whatever tends to improve the patient's general condition is indicated. Exercise in the fresh air is good, but the pernicious effects of cold must be avoided. Paracentesis of the cornea rarely does good, but occasionally iridectomy may be of benefit. The complication of iritis or irido-choroiditis is not common, though it does occur. When the disease becomes very chronic there will be hardly vascularity enough for the purposes of repair. This being the case, stimulating collyria may be used, similar to those indicated in conjunctivitis. Olive oil and spirits of turpentine, in equal parts, may be applied to the eye every second day. Bathing with warm water sufficiently to congest the eye will sometimes be serviceable. An attack of acute conjunctivitis has been known to do good. But, do what we may, this affection sometimes runs on unchecked for a very long time. It rarely destroys the sight, but I recently treated a case from the beginning, and in spite of treatment there was only perception of light remaining. I have heard of only one other similar case. From some recent experiences I am inclined to believe that bichloride of mercury internally and atropine as a collyrium are of as much value as any other agents in the treatment of this obstinate malady.

CHAPTER III.

TUBERCULOSIS.

THE term "tuberculosis" is applied to a disease which is characterized by the formation of small tubercles or nodules in one or more organs. Though more prevalent in some countries or localities than in others, it occurs in all or nearly all parts of the globe from which we have exact information, and it has been more destructive to human life than any other one disease.

ETIOLOGY.—One of the most important discoveries of recent years relating to the etiology of diseases is that of the specific principle of tuberculosis. It has long been suspected by observing physicians that a specific cause did exist, and that this disease is to a certain extent infectious, but it is only recently that patient microscopic investigations have triumphed over the difficulties which surround this subject, and have detected the micro-organism which has been so fatal to the human race. The honor of its discovery belongs mainly to Dr. Koch of Berlin. In his investigations Koch invariably found a certain bacillus in all recent tubercles, proving beyond a doubt that they always accompany the development of the tubercular nodule. By inoculating guinea-pigs, rabbits, and cats with tubercular material he communicated tuberculosis, reproducing the tubercular nodule, in which he always found the same bacillus. But it still remained to determine the relation of the bacillus to the tubercle, whether it was merely an accidental accompaniment, or whether it sustained a causal relation, producing the nodule by its irritating action on the cellular elements of the part where it happened to lodge. After many trials Koch succeeded in preparing a pabulum in which the bacilli grew and reproduced their kind. By adding a little of the first cultivation to the pabulum, he produced a second cultivation, and after a series of cultivations he produced a bacillus which was evidently freed from all other substances. With the bacillus of the last cultivation he was able to produce the tubercular nodule, having all the characteristics which are observed when it is developed in the usual way in man. Different micro-organisms take coloration differently, and Koch was enabled to discriminate the tubercular bacillus under all circumstances from other microbes by the peculiar color imparted to it.

The tubercle bacilli have the form of "delicate rods from a quarter to half the diameter of a blood-corpuscle in length." The more severe the tuberculosis, the greater the number of bacilli. They occur not only in the recent tubercle, but also in immense numbers in the periphery of the caseous masses of a tubercular patient. They are found not only elsewhere, but also in the interior of the giant-cells, as many as twenty even in some cells. They do not seem to have the power of movement, and oval spores are found in some of them. They grow in a temperature of 86° to 104° F., and not in a temperature outside these limits.

As might be expected, these microscopical researches of Koch have attracted wide attention, and have led to a repetition of his experiments by many pathologists, and to new experiments relating to the etiology of tuberculosis. The result has been to establish more firmly the views of Koch, and the doctrine that tuberculosis is a specific disease, and that the bacillus is the specific principle, appears to be fully established.

Among the most thorough and convincing researches bearing on the causal relation of micro-organisms to tuberculosis, growing out of Koch's discovery, were those contained in a report to the London Association for the Advancement of Medicine by Research (*Practitioner; London Lancet*, March 17, 1883). Experiments were made with the cultivated bacilli obtained from Koch. "Twelve animals were inoculated with these organisms, chiefly into the anterior chamber of the eye, and all of them becàme tuberculous, and that more rapidly than after inoculation of tuberculous material. The tubercles produced in these cases were infective and caused tuberculosis in other animals. On examination of tuberculous material Koch's tubercle bacilli are always found, though in varying numbers. . . . . About eighty organs of tuberculous animals and thirty-six cases of human tuberculosis were examined, and in all of these, without exception, tubercle bacilli were found."

The discovery of Koch has already proved of great importance as an aid in diagnosis, for the sputum of tubercular patients contains the bacillus. Tubercular sputum affords a soil in which the bacillus thrives and multiplies, as it does in the tissues of a tubercular patient, and by careful microscopic examination we are able to discover it in this sputum, while it is absent from non-tubercular sputum. According to Frisch (*Wiener med. Woch.*, No. 46, 1883), the bacilli were found without an exception in the sputum of 140 patients with confirmed tuberculosis, while the sputum of 150 non-tubercular patients was in every instance free from them. Heitler (*Wiener med. Woch.*, No. 43, 1883) examined the sputum of 140 tubercular patients, 1 of whom had miliary tubercles, and 1 other caseous pneumonia. All the other cases were chronic and were grouped by the author as follows: 1st, 6 cases of old infiltration of the apices of the lungs, cured with the persistence of dulness on percussion, without râles; no bacilli observed. 2d, 12 cases of tuberculosis with slight dulness and dry râles. In 2 of these, notwithstanding marked physical signs, fever was absent and the tubercular process was arrested apparently; no bacilli. In the sputum of the remaining 10 cases bacilli were present in all the examinations except 2. The third group contained cases of advanced and progressive tuberculosis, and the fourth group cases of advanced chronic phthisis, but with remissions. In the sputum of these two groups bacilli were always observed. That Heitler in 6 instances witnessed the disappearance of bacilli when the tubercular process was arrested is an interesting fact, as showing the relation of the bacilli to tuberculosis. He examined the sputum of 29 non-tubercular patients, patients with pneumonia, bronchitis, bronchial dilatation, and putrid bronchitis with gangrene, and in no instance found the bacilli of tuberculosis.

As usually happens when a great discovery is announced, there are dissentients; there are those apparently competent to express an opinion, as Spina and Formad, who do not accept, or only partly accept, the views of Koch. But the testimony of many observers, constantly accumulating, tends to establish more securely the doctrine of the parasitic origin of tuberculosis, and it is now apparently as securely established as most doctrines in pathology.

Koch's discovery necessitated revision of the teachings long accepted relating to tuberculosis. The tubercle nodule is, as we will see, an aggregation of cells produced from the cellular elements of the part where the nodule appears through a proliferating process caused by an irritant, and in the light of our present knowledge we consider the bacillus to be the irritant. A local corpusculation and a cellular nodule may be produced in the lungs or elsewhere by the lodgment of a non-specific irritant, whether organic or inorganic, as putrid cheese, particles of dust, or metallic particles, and thus far no cells have been discovered in nodules thus produced which are characteristic of tuberculosis. The giant-cells which at one time were thought to be peculiar to the tubercular nodule have been found in growths of another nature, as in gummata. The characteristic and peculiar element in the tubercular nodule is the bacillus.

It has long been the belief from clinical observations in Southern Europe, and of certain observing physicians in the temperate regions of Europe and America, that phthisis is contagious, and the acceptance of the parasitic theory will probably soon render this belief an established principle in pathology. Already many instances have been published in the journals which appear to show the infectiousness of tuberculosis, as the following: In an inland town in Europe a midwife with advanced phthisis had been in the habit of blowing into the mouths of new-born infants, and so many of them perished of tubercular disease as to excite attention and cause alarm, while those attended by a healthy midwife remained well. Dr. E. I. Kempf relates the following striking example in the Louisville *Medical News* for March 22, 1884: In the fall of 1880 a girl of eighteen years, whose brother had died of consumption, was found to have tubercles at the apices of both lungs. She belonged to a sisterhood, and slept in the general dormitory with the other sisters. In four months nine of her companions began to cough and were found to have tubercles. No one of the sisterhood had previously had disease of this kind. Dr. A. Ollivier, physician to l'Hôpital des Enfants-malades, Paris, states that a family having uniform robust health occupied two small rooms opening into a narrow court. The parents, a young son, and the baby slept in one of the rooms. An older son, who had been living elsewhere, contracted phthisis, returned home, and slept in the same apartment. He died January 16, 1883. His mother, who was constantly at his bedside, began to cough, emaciated, and died of the same disease in the following May. Seven days after the death of the mother the infant had tubercular meningitis, of which it perished; and the older child, who occupied the same apartment, sickened and died like the mother. The father only survived of those who occupied the small room (*Études d'Hygiene publique*, 1886). The fact that wives devoted in their attendance on consumptive husbands frequently perished of the same disease physicians in various countries have long remarked, but it has usually been attributed to the depressed state of system incident to long watching and grief, and not to any contagious property. But now that a clearer insight has been obtained into the nature of tuberculosis, and both microscopical researches and clinical facts indicate its communicability, more caution will be exercised in the intercourse with patients.

The recent experiments of Cornet (*Wiener med. Wochen.*, June 2, 1888) appear to show that the walls and furniture of a room occupied by a phthisical patient may be infected by the lodgment of the tubercle bacillus upon them, so that any one occupying this apartment subsequently is in danger of contracting the disease. He rubbed the walls and bedsteads in the ward occupied by phthisical patients with disinfected sponges, avoiding such surfaces as might be infected by the hands and sputum of patients; 94 animals were inoculated with these sponges, and 52 of them died, apparently of causes different from tuberculosis; the remaining 44 were killed after forty days, and

20 of them had tubercles. 168 animals were inoculated with the dust from the walls of rooms occupied by phthisical patients in family practice. Of these animals 90 died soon afterward. Of the remaining 78, 34 contracted tuberculosis. In control-experiments, the dust being used from surgical wards, operating-rooms, and from crowded thoroughfares, the result was negative as regards the production of tuberculosis. "It has been abundantly demonstrated by numerous experiments that the milk from tuberculous cows is capable, when ingested, of causing tuberculosis. How serious is this danger may be seen from the statistics of Bollinger, who found the milk from cows affected with extensive tuberculosis infectious in 80 per cent. of the cases, and that from cows with moderate tuberculosis infectious in 33 per cent. of the cases. . . . . Bollinger estimates that at least 5 per cent. of the cows in dairies are tuberculous. From statistics furnished me by Mr. A. W. Clement. V. S., the number of tuberculous cows in Baltimore which are slaughtered is not less than 3 to 4 per cent."[1]

The causal relation of scrofula to tuberculosis we have considered elsewhere, but we may here repeat that scrofulous ailments, especially the caseous products, afford the soil which is favorable to the growth and multiplication of the bacilli. Hence these microbes are not infrequently found in scrofulous products, showing that the tubercular has supervened on the scrofulous disease. Kanzler treats of the relation of scrofula to tuberculosis in the *Berlin. klin. Woch.*, January 14, 1884. He believes that the two diseases are distinct. but that, as expressed by the French reviewer, *la scrofule offre un terrain de prédilection pour le développement de la tuberculose*. He has discovered bacilli only in a minority of the local manifestations of scrofula, never in glands which had not undergone suppuration or caseation, never in eczema, impetigo, suppurative otitis media, and never in the nasal, conjunctival, pharyngeal, and vaginal catarrhs of the scrofulous. It is not till degenerative changes have occurred in the inflammatory products of scrofula that the bacilli of tuberculosis appear, indicating the supervention of the latter disease.

Anatomical Characters of the Tubercle.—As Virchow pointed out, the tubercular nodule when recent is semi-translucent and small, attaining about the size of a millet-seed and consisting mainly of cells. The cells of which it is chiefly composed resemble the white corpuscles of the blood in appearance and size, but some are smaller and others larger than those corpuscles. They have been designated the lymphoid cells. Each cell when fully developed has a bright homogeneous nucleus, small and spherical or large and oval, and nucleoli. A large cell sometimes contains two or more nuclei. The lymphoid cells appear to be developed from the cellular element of the connective tissue. This is Virchow's belief. In addition to these cells, which constitute the greater part of the tubercle, large uninuclear cells are also observed, designated epithelioid cells. They resemble large and swollen endothelial or epithelial cells, and they are believed by pathologists to be produced from these cells, which lie within the area of the nodule. A third cell also occurs, known as the giant-cell from its size. It has many nuclei, and occupies chiefly the central part of the nodule. All these cells, as has been recently shown, occur in other pathological products besides the tubercular nodule, and no one of them is therefore characteristic of it. But the element which is of greatest importance, since it sustains a causal relation to the disease, was, as we have seen, the last discovered. The bacillus is always found in the recent tubercle lying without the cells, as we have stated, but also in the interior of the giant-cells, for which it appears to have an affinity. A fibrous network with more or fewer blood-vessels surrounds the cells and holds them together. The blood-vessels belong to the normal tissues, and are not

[1] Prof. W. H. Welch's *Address before the Amer. Med. Assn.*, 1889.

a new growth, the tubercle having developed around them. The tubercles are single or in clusters, forming masses of considerable size.

When the tubercle has attained a certain age, caseation always occurs in its centre and extends outward, causing an opaque and yellowish-white dead mass, in which fragramentary cells can be observed under the microscope. Caseation is now known to be a form of decay which is common to pathological products of different kinds, and is not peculiar to tuberculosis, as was supposed before the time of Virchow. It occurs in consequence of abundant exudation or cell-formation and the compression and obliteration of vessels. It is therefore more common in scrofula than in any other disease, since scrofulous inflammations afford the conditions in which it is especially liable to occur. The yellow tubercle is therefore only an advanced stage of the semi-transparent or miliary tubercle. In the cheesy metamorphosis granules of fat are deposited within and around the cells, and the cells shrivel and disintegrate. The shrunken granular and fragmentary cells were believed to be the true tubercular cells until Virchow pointed out their character. When the tubercle or tubercular mass becomes yellow or caseous, and circulation ceases in it, it is surrounded by a vascular zone in which circulation still continues. It is very seldom, perhaps never, absorbed, although particles of it may enter the lymphatics or blood-vessels and be carried elsewhere with the bacilli. It is an irritant, producing inflammation in the surrounding tissues, with thickening, induration, and abundant production of pus-cells, which mingle with the elements of the tubercle. Its history henceforth is that of an abscess, and ulceration and discharge of the liquefied substance upon one of the free surfaces is the common result. In rare instances the tubercle, instead of cheesy degeneration, undergoes fibroid degeneration or cretefaction.

Various pathological conditions furnish the soil in which the bacillus obtains lodgment and grows, and in this way becomes a cause of tuberculosis. Cheesy pneumonia and exhausting suppurative surfaces often afford a nidus favorable for the development of the tubercle bacillus. During epidemics of measles many cases occur of cheesy pneumonia ending in tuberculosis. Cheesy and disintegrating lymphatic glands, as the bronchial, often become tubercular.

Anatomical Characters in Infancy and Childhood.—The anatomical characters of tuberculosis in the first years of life vary in certain particulars from the form which they present in the adult, but after the age of three years the differences are fewer and less pronounced than previously.

Tubercular laryngitis, so common in the adult, is absent in a large proportion of cases under the age of three years, and when present it has little intensity. Ulceration of the larynx very seldom occurs. This has been attributed to the fact that there is so little expectoration in young children, the sputum being an irritant. Niemeyer, however, does not consider the sputum of tuberculosis sufficiently irritating to cause laryngitis and laryngeal ulceration; but the arguments in favor of this mode of causation, in my opinion, more than counterbalance those which have been presented against it.

I have never met a case of tubercular ulceration of the larynx or trachea in the post-mortem examination of young children, nor do I recollect ever treating a case in which there was that degree of dysphonia which indicated ulceration. Rilliet and Barthez, in more than 300 necropsies of tubercular cases, found no ulcers in the larynx or trachea under the age of three years, but met 8 cases between the ages of three and ten years, and 8 between ten and fourteen years. The ulcers, whether seated in the larynx or in the trachea—and they are in most cases in the former, since the inequalities upon the surface of the larynx favor the retention of the sputum—are commonly small, superficial, round or elongated, and with little thickening or infiltration of their borders. Occurring in the folds of the mucous membrane—as, for example, around the vocal cords—their form is usually elongated.

Bronchitis is not infrequent. This inflammation is due to, and dependent on, the pulmonary tubercles, and is therefore most intense in the part of the lung where the tubercles are most abundant and farthest advanced. Consequently, it is more intense on one side than on the other, and it may be unilateral. It differs in this respect from idiopathic bronchitis, which is commonly nearly uniform on the two sides. It differs also in the fact that it is sometimes accompanied by ulcerations. The ulcers are round or elongated in the direction of the axes of the tubes, and, like those of the larynx or trachea, are superficial. Circumscribed inflammation may attack a bronchial tube, as, indeed, the trachea, and give rise to ulceration and perforation from the pressure of a diseased lymphatic gland external to the tube. This subject will be treated of hereafter.

Lungs.—It is well known that in the adult tubercles are always present in the lungs if they occur in any part of the system. I have met 2 cases in which the lungs were free from tubercles in 36 post-mortem examinations of children who died of tuberculosis. One of the two was an infant, but its exact age is not stated in the records. It had cheesy degeneration of the thymus and bronchial glands, enlargement of the mesenteric glands, but without cheesy degeneration, and disseminated tubercles in liver and spleen. The other, fifteen months old at death, had tubercular meningitis, with numerous granulations upon the convexity of the brain, and the other usual lesions of meningeal inflammation, with bronchial and mesenteric glands slightly enlarged and cheesy, and one of the former softened. In 1 case, then, in 18 the lungs had escaped the disease. Rilliet and Barthez in their statistics of the state of the lungs in infancy and childhood found these organs non-tubercular in 47 cases in 312, and Hillier in 25 cases in 160. Therefore, the lungs were exempt from tubercles in about 1 case in 7. But it is to be recollected that the observations of these physicians were made at a time when all cheesy degenerations were thought to be tubercular, so that their published statistics may not have been strictly accurate.

Pulmonary tubercles in children under the age of three years are, as a rule, discrete and disseminated through the lungs. In cases at this age which have advanced to a fatal termination we find yellow tubercles from the size of a pin's head to that of a shot in the different lobes; many still semi-transparent if the disease have been of short duration, but if protracted most of them yellow, and here and there one softened and surrounded by condensed fibrous tissue. Around the semi-transparent or gray tubercles, many of which were growing, and therefore were in the state of active cell-proliferation at the time of death, vascular zones can often be detected by the naked eye.

Under the age of three years tuberculosis exhibits but little tendency, perhaps none, to affect the upper lobes sooner or in greater degree than the lower.

The following are the statistics relating to the site of the tubercles in the lungs in the cases which I have examined; all, it is to be remembered, were under the age of three years:

	Cases.
Tubercles disseminated throughout the lungs	26
Tubercles disseminated throughout the two upper lobes	3
Tubercles disseminated through right middle lobe and left lower lobe only	1

	Cases.
Tubercles disseminated through left upper lobe only	2
Tubercles disseminated (few and semi-transparent) in left lung only	1
Tubercles disseminated in three points in right and two in left lung	1
No tubercles in lungs	2
	36

Between the ages of three and fifteen years statistics show that the upper lobes are more liable to tubercles than the lower; but the difference in liability is not great. In many cases occurring in this period the different lobes are affected nearly simultaneously, and not very infrequently the upper lobe is the last which is involved. In October, 1866, I made the post-mortem examination of a boy who died in the Children's Service of Charity Hospital at the age of fifteen years, and small scattered tubercles were found in the lower lobe of the left lung, while all other portions of these organs were healthy. Rilliet and Barthez, who include in the same statistics all cases from birth to the age of fifteen years, found gray semi-transparent tubercles—

	Cases.
In the right superior lobe in	63
In the right middle lobe in	43
In the right lower lobe in	55
In the left superior lobe in	65
In the left inferior lobe in	54

The same observers found yellow tubercles in the

Right superior lobe in	40
Right middle lobe in	28
Right inferior lobe in	39
Left superior lobe in	35
Left inferior lobe in	31

Tubercle, especially when softening commences, is itself an irritant, exciting inflammation around it. Inflammation occurring from this cause is obviously likely to be protracted, continuing for weeks or months unless the tubercular matter be eliminated by ulceration. The highly vascular and delicate lungs of the young child are very liable to inflammation when they are the seat of tubercles, and as the tubercles are disseminated, the pneumonia is commonly more extensive than when it occurs from ordinary cases. In fifteen, or nearly one-half, of my cases there was pneumonia affecting portions of one or more lobes or an entire lobe. From the extent and position of the solidified portions it was obvious that in most instances the inflammation originated from the irritating effect of the tubercular matter, while in others it was due to hypostatic congestion, occurring in consequence of the long-continued recumbent position and feebleness of circulation. In these 15 cases the seat and extent of the pneumonia were as follows:

	Cases.
Nearly entire right lung	2
Nearly entire middle and lower lobe of right lung	1
Entire left upper lobe	2
A considerable part of both lungs	1
Posterior parts of both lower lobes	4
Posterior part of left lung	1
Left lower lobe, and right middle and lower lobes	1
Left upper lobe (contained a large cavity) and posterior part of left lower lobe	1
Nodules of inflamed lung around tubercles	2

The inflammation in about one-third of the cases was due to hypostasis, since it occurred in depending portions, extended but little into the lungs, and sustained no relation to the amount of tubercle. It was in the stage of red—or, more rarely, of gray—hepatization.

In 7 of the cases there were pulmonary cavities as large in proprotion as we ordinarily find in tuberculosis of the adult. The seat of 1 was in the right lower lobe; of 2, the left upper lobe; of 1, the right upper lobe; of another, the right lung, its exact seat not stated; and in the remaining case the cavity, which was the largest of all, occupied the interior of all three lobes on the right side. Some idea of the size of these cavities may be learned by the following extracts from the records: 1st Case. "A small superficial cavity communicating on one side with a bronchial tube, and on the other side with a small circumscribed collection of pus in the pleural cavity." 2d Case. "Cavity of the size of a hickory-nut." 3d Case. "Cavity of the size of a large hickory-nut." 4th Case. "Cavity three-fourths of an inch in diameter." 5th Case. "A large abscess." 6th Case. "The cavity occupied nearly the whole of the interior of the left upper lobe." 7th Case. "About half the right lung excavated into a cavity which extended through the three lobes."

Circumscribed pleuritis, produced by tubercles underneath the pleura, was observed in 7 cases. It was ordinarily attended by little exudation except the fibrin, but in 1 case a sufficient amount of serum had been exuded to compress considerably the lung. Pus was not observed in any notable quantity.

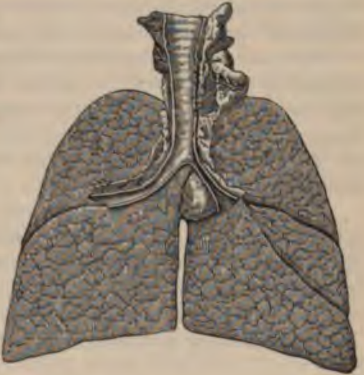
Emphysema was present in several cases, chiefly in the upper lobes, sometimes vesicular, with fulness or bulging of the lung, an anæmic appearance of it, and doughy, inelastic feel. In other cases emphysema was interstitial, producing little bladders of air under the pleura, especially toward the root of the lung, or separating the lobules by wedge-shaped or irregular interspaces filled with air. In one case air had escaped from an emphysematous bladder into the right pleural cavity, causing pneumothorax and collapse of the lung.

Next to the lungs, the bronchial glands are more frequently diseased than any other organs in the tuberculosis of infancy and childhood. They undergo the successive structural changes which characterize glandular inflammations—to wit, hyperplasia—and more or fewer of them cheesy degeneration and softening. In the state of hyperplasia their firmness is diminished and they have a pale flesh-color. Cheesy degeneration commences in one or more points in the gland, sometimes in the peripheral, sometimes in the central portion, and it extends till the whole gland presents the well-known cheesy appearance. When the gland softens the thick liquid has a puriform appearance, consisting of amorphous matter, fatty particles, and the shrivelled and disintegrated cells of the gland. Soon pus-cells occur, and their number increases. The cheesy gland may or may not be tubercular. If it be tubercular, the tubercle bacillus will be found in it.

Rilliet and Barthez state that the bronchial glands were tubercular (caseous) in 249 cases in children, while the lungs were tubercular in 265. All cheesy glands, it is to be recollected, they considered tubercular. In 4 of the 36 cases which I have examined no record was preserved of the state of the bronchial glands; in 1 case there was no perceptible hyperplasia and no cheesy degeneration; in 2 there was hyperplasia, but no cheesy degeneration, while in the remaining 29 cases cheesy degeneration had occurred in some of the glands or in parts of them, with occasional softening. The enlarged and caseous bronchial glands afford an explanation in part of the fact that the symptoms in the tuberculosis of young children differ from those in the adult, since Louis found the bronchial glands involved in only 28 per cent. of the adult cases of tuberculosis which he examined, and Lombard in only 9 per cent. A gland pressing upon the recurrent laryngeal or pneumogastric nerve or the trachea may give rise to dyspnœa and a cough; or on the descending vena cava or one of the venæ innominatæ to congestion of the brain and meninges, intracranial serous effusion, and even thrombosis in the cranial sinuses. That a softened bronchial gland is not infrequently eliminated from the system by ulceration into a bronchial tube or into the trachea is well known. In one case which I observed the ulceration had destroyed portions of three of the cartilaginous rings of a bronchus, and the aperture was plugged by a cheesy fragment of a softened gland which protruded. Occasionally, it is stated by authors, the ulceration is into one of the large vessels of the mediastinum, or even into the œsophagus.

The following is an example of bronchial phthisis as it commonly occurs. This case, which is not included in the foregoing statistics, was seen almost daily by me during its entire progress: On September 3, 1874, I examined an infant in the New York Infant Asylum who had wheezing respiration during the last eight days. The wheezing occurred both in inspiration and expiration, and also, though less pronounced, during sleep; pulse 96, respiration 40, temperature normal. Its mother, who had charge of it, and had till recently wet-nursed it, had unequivocal symptoms of tuberculosis for several months. The child was pallid and its flesh was soft and flabby. The fauces were perhaps a little redder than usual, but were otherwise normal, and a careful exploration of the chest revealed no cause of the embarrassed respiration. Auscultation and percussion gave a negative result. In the latter part of September a troublesome diarrhœa occurred, which continued more or less till near death. The temperature on September 28th, October 8th, 10th, and 11th, was 100½°, 100°, 99½°, and 100°. The pulse on October 10th and 11th was 120 and 126. On October 8th the percussion-sound over the upper part of the right lung seemed somewhat duller than on the other side, though the respiration was not observed to be notably changed in the area of the dulness. There was but little cough during the entire sickness. Death occurred on October 20th. At the autopsy the bronchial glands were found enlarged and cheesy, and underneath the right bronchus, near the bifurcation, was a softened, almost diffluent gland, as large as a small hickory-nut and compressing the bronchus. This, no doubt, had produced the wheezing respiration, which had been the chief local symptom. The lungs, spleen, and in less degree the liver, contained numerous small miliary tubercles. Certain of the mesenteric glands were also cheesy, but to a less extent than the bronchial. The disease of the bronchial glands was evidently primary, the tubercles of the lungs and abdominal organs being apparently quite recent. The accompanying woodcut, from a photograph by Mr. Mason, the photographer at Bellevue Hospital, represents a posterior view of the lungs and air-passages.

FIG. 24.



In no case have I found tubercles in the heart or pericardium, though they have been observed in rare instances in the latter. The mesenteric glands were enlarged by hyperplasia and more or less cheesy in 30 cases, were apparently normal in 2 cases, while in the remaining 4 cases their condition was not stated. In most of the patients the mesenteric glands were smaller and less cheesy than the bronchial, but in a few instances they were larger than the bronchial and more cheesy.

It is a noteworthy fact, as bearing on the causal relation of these glands to tubercles, that not infrequently the amount of hyperplasia and cheesy degeneration occurring in the former was very considerable, while the tubercles in the lungs or elsewhere were small, even minute, semi-transparent, and apparently of recent formation. It was evident in such cases that the glandular hyperplasia and degeneration, bronchial or mesenteric, or both, preceded the tubercular disease, and furnished the conditions favorable for the lodgment and propagation of the tubercle bacillus. Since the cases which furnished the above statistics occurred my clinical experience with tuberculosis has greatly increased, but nothing new or different has been observed at autopsies.

Abdominal Viscera.—In children tubercles in the solid organs of the abdomen rarely give rise to appreciable symptoms, since they are small and disseminated, not impairing materially the function of the part in which they are located. On the other hand, peritoneal and intestinal tubercles and the enlarged and cheesy mesenteric glands give rise to symptoms which require description. The most frequent seat of peritoneal tubercles is upon the attached surface of the peritoneum, where they are formed in the connective tissue. They are distinctly seen through the peritoneum, and cause some prominence of it. Exceptionally their seat is upon its free surface. Every portion of the peritoneum, whether visceral, parietal, or omental, is liable to tubercles, but general tuberculization of so extensive a surface seldom occurs in any one case. The tubercles are spherical or lenticular, and most of them small. Sometimes they are very numerous, but so minute as to be scarcely visible. They are gray or yellow according to their age. Peritoneal tubercles often produce circumscribed peritonitis, causing adhesion of opposite surfaces. The tubercles in themselves cannot be detected by external palpation; but masses composed of tubercles and inflammatory products are sometimes so large that they can be felt through the abdominal walls.

The symptoms of peritoneal tuberculosis are attributable, for the most part, to the peritonitis. Among them may be enumerated abdominal tenderness or pain, meteorism, ascites—usually slight—and derangement of the bowels, commonly diarrhœa. Since tubercles in this situation occur, in most cases, subsequently to tubercles elsewhere, the symptoms which have been described are associated with and are subordinate to others.

Stomach and Intestines.—The most common seat of gastro-intestinal tubercles is the small intestine, and more frequently its lower portion, near the ileo-cæcal valve, than its upper or central. They are rare in the duodenum or contiguous part of the jejunum. They are developed ordinarily in the connective tissue, either that lying under the mucous or the serous surface.

Gastro-intestinal tubercles are often accompanied by ulceration of the adjacent mucous membrane. But in a certain proportion of cases, probably, the tubercles do not cause the ulcers, for ulceration of this membrane is not infrequent in the tuberculosis of children, when there are no tubercles in the walls of the stomach or intestines. The following statistics of Rilliet and Barthez relating to this point will aid to an understanding of the symptoms:

Tubercles in walls of stomach, 7 cases, { with ulcers, 6 cases.
{ without ulcers, 1 case.
Ulcers of gastric mucous membrane, without gastric tubercles, 14 cases.

Tubercles in small intestine, 82 cases, { with ulcers, 70 cases. / without ulcers, 12 cases.
Ulcers without tubercles in small intestine, 51 cases.
Tubercles in large intestine, 15 cases, { with ulcers, 10 cases. / without ulcers, 5 cases.
Ulcers in large intestine, without tubercles, 47 cases.

The ulcers have vascular, thickened, and infiltrated borders. Their diameters vary from a line to half an inch or more, and their general form is circular, or, if two or more unite, irregular. Tubercular ulcers of the stomach are mostly in the great curvature, those in the small intestines in the ileum and lower part of the jejunum, and those of the large intestine in the cæcum.

The following table exhibits the state of the principal abdominal viscera in the 36 cases embraced in my statistics:

	Liver.	Spleen.	Kidneys.
Tubercular	12	22	1
Non-tubercular	16	6	21
Not stated	8	8	14
Fatty	5	0	0

In no instance did I observe tubercular softening in the abdominal organs, and a large proportion of the tubercles in the liver, spleen, and kidneys were still in the first stage. In the 5 cases in which the liver was recorded fatty this state of the organ was obvious to the sight, as it is in tuberculosis of the adult. A moderate excess of fat in the hepatic cells may have been present in some of the other cases, but it was not sufficient to be appreciable without the microscope. It is to be remarked that in the 5 cases in which the liver was recorded fatty this organ contained no tubercles. The spleen is seen to have been the most frequent seat of tubercles of all the viscera, except the lungs. In 14 cases the intestines were examined; and in 5 tubercles discovered, developed in their connective tissue. The intestinal tubercles were small, and ulceration had occurred of the mucous membrane which covered them.

The brain was examined in 15 cases. In 12 the amount of cerebro-spinal fluid varied from ℥ss to ℥v by estimation. In 2 others the records state that there was a considerable amount of this fluid, the exact quantity not being given, while in the remaining case congestion of the brain and meninges was noticed, but nothing was recorded in regard to the amount of cerebro-spinal fluid. The increase of the cerebro-spinal fluid in tuberculosis is attributable to wasting of the brain, a *hydrocephalus ex vacuo*, and in some cases to passive congestion and serous transudation, due to feeble circulation, or obstructed flow from the pressure of bronchial glands on the vessels within the thorax, as already stated.

Tubercles were present in the pia mater in 3 cases: in 2 with fibrinous exudation; in the other without fibrin or other evidence of inflammation. Tubercular meningitis is described in another part of this book.

SYMPTOMS.—The symptoms in tuberculosis of children arise in part from the diathesis and in part from the tubercles. Before the period of tubercles there are signs of failing health, such as loss of appetite, flabbiness of the soft parts, or emaciation, lassitude, and loss of strength. These symptoms continue after the formation of tubercles, and increase.

The features are ordinarily pallid, but during the paroxysms of fever, to which tubercular patients are subject, they may be flushed. Lividity of the features, due to imperfect decarbonization of the blood, occurs if there be enlarged bronchial glands which compress the vessels within the thorax, or if there be extensive pulmonary tuberculization or pulmonary tuberculization, whether extensive or not, which is complicated by capillary bronchitis or pneumonia.

The skin is nearly natural, or it loses its flexibility and softness and becomes dry and rough. In some patients there is, at times, general or partial furfuraceous desquamation of the skin, due to exaggerated development of the epidermis. Children, like adults, notwithstanding the general dryness of the surface, are liable to perspirations at night and in sleep. This symptom is less frequent at the commencement than at an advanced period, in acute than in chronic cases, and in those under three or four months than in older children. It is more abundant about the head and limbs than elsewhere, and is sometimes confined to these parts.

Anasarca is not infrequent. It sometimes arises from obstructed circulation in consequence of compression of the thoracic vessels by enlarged lymphatic glands; in other cases it is due to diminished plasticity of the blood, a result of the tubercular cachexia. The latter is the more common cause. It is not an important symptom, on account of the small amount of serous transudation and the character of the parts in which it occurs.

Emaciation, already alluded to, is early, constant, and progressive. Under the age of six or eight months it is less marked than in older children, many preserving considerable rotundity of features and form even in advanced tuberculosis. The failure of the strength corresponds in amount and progress with the emaciation. Slight at first, and exhibited only by a degree of lassitude, it gradually increases, till for weeks before death the little patient is fatigued by the ordinary muscular movements, and is inclined to be quiet.

The nervous system is not ordinarily affected except in cases of intra-cranial tubercles. In acute tuberculosis or tuberculosis complicated by severe inflammation there may be agitation and delirium, especially at night.

In most patients the mucous membrane of the buccal cavity presents its normal appearance, with the exception of a moist fur upon the tongue and a paler hue than normal of its surface generally. In acute tuberculosis and in cases complicated by inflammation the tongue is sometimes dry and brown. The appetite may be normal till the close of life or it is poor or changeable. Occasionally it is increased, although the disease is progressing. The bowels are regular or relaxed. Diarrhœa may be a prominent symptom, even when there are no intestinal tubercles or ulceration. Meteorism and fulness of the abdomen are common.

Fever, constant, but usually with evening exacerbation, is rarely absent. It continues for weeks or months. During the exacerbation the pulse rises to 120, 140, or even to 180 beats per minute, and there is a corresponding exaltation of the temperature, which in the latter part of the day, without inflammatory complication, ranges from 100° to 102° or 103°. The febrile movement is a symptom of diagnostic value as regards the nature of the disease, though it does not indicate the seat of the tubercles.

In addition to the symptoms now described, there are *special* symptoms due to tuberculization of the different organs. In young children, on account of the fact already referred to—to wit, the tendency to a generalization of tubercles—there is often a blending of the symptoms which arise from different organs, but with care it is not difficult in most instances to isolate and refer them to their proper source. The following are the symptoms which arise from tuberculization of the more important organs:

Encephalon.—The symptoms produced by tubercles of the encephalon vary according to their seat and size and the structural changes in surrounding parts to which they give rise. Meningeal tubercles, which are located for the most part in the meshes of the pia mater, and ordinarily along the course of the small arteries, are, as a rule, small, not more than a line in diameter, and they may remain latent for a considerable time. In the majority of cases, however, they sooner or later cause meningitis, the symptoms of which are well known and need not be described. But tubercles in this situation do sometimes give rise to symptoms when there is no meningeal inflammation. They occasion congestion of the surrounding vessels and serous transudation, and, if developed on the under surface of the pia mater, they may produce symptoms by encroaching upon and irritating the brain; for they are sometimes so much imbedded in the convolutions that careful examination is required in order to determine that they are meningeal and not cerebral. Among these symptoms may be mentioned headache, frontal or occipital,. sometimes intermittent, nausea, melancholy, and in certain cases the symptoms produced by serous transudation.

The symptoms of *cerebral* are in part similar to those of meningeal tuberculosis, but in most cases others of a neuropathic character are present, which serve for differential diagnosis. The differences as regards the symptoms of different patients having cerebral tubercles are attributable in part to their size and rapidity of growth, but more to the difference in their seat; for any part of the brain may be the seat of tubercles, though certain portions, as the cerebellum, are more frequently affected than others.

The child with cerebral tubercles is quiet, but irritable and easily excited. Delirium is not common, but many before the close of life exhibit a degree of mental dulness. The headache, common in cases of cerebral as well as meningeal tubercles, may be nearly general, or it is frontal, parietal, or occipital according to the seat of the tubercles. It is often lancinating, often intermittent.

Clonic convulsions occur toward the close of life. Exceptionally, they are among the earliest symptoms. Observations have failed to establish any relation between the seat of the tubercles and the localization of the convulsions. The convulsions may be unilateral, while the tubercles are in both hemispheres; or general, while the tubercles are on one side only.

The severity and duration of the convulsive attacks, and the frequency of their occurrence in tuberculosis of the brain, vary greatly in different patients. They have been attributed to softening of the cerebral substance, which sometimes occurs immediately around the tubercles, to local congestions excited by them, and also to serous effusions in the ventricles. The convulsions sooner or later end in paralysis or coma.

Contraction, or tonic spasm of certain muscles, is sometimes observed. Its most frequent seat is in the muscles of the back and of one or both of the lower extremities. It is a late symptom. It occurs in those cases in which there is softening around the tubercles, and usually in the muscles of the opposite side.

Paralysis is also a late, but not an infrequent, symptom. It is preceded by headache, and sometimes, as already stated, by convulsions. Occurring as a symptom of tuberculosis of the brain, it is due either to pressure on a cranial nerve or to compression and perhaps softening of the cerebral substance. The paralysis may be paraplegic, commencing as feebleness of the lower extremities, and increasing until it becomes complete, or more or less complete, hemiplegia. In paraplegia due to tubercles of the brain the cerebellum is, as a rule, their seat; while paralysis of one side or of certain muscles of one side indicates tubercles of the opposite cerebral hemisphere; but there are exceptions. Paralysis of the third cranial nerve gives rise to ptosis

—of the sixth, to paralysis of the external motor nerves of the eye, and therefore to internal strabismus.

Feebleness or loss of vision, inequality, oscillation, and finally dilatation of the pupils, are not infrequent symptoms of tuberculosis of the brain, and they possess great diagnostic value. Atrophy of the optic nerve, causing amaurosis, sometimes results from tubercles as well as other tumors of the brain. Atrophy of this nerve occurs not only when the tubercles are so located as to press on the optic tract, in which case the explanation is apparent, but also, in certain patients, when the tubercles are in other parts of the brain. In these last cases it is thought by Brown-Séquard and others that the imperfect nutrition of the nerve is due to contraction of its nutrient vessels, produced by the tubercles through reflex action.

In tuberculosis of the brain symptoms pertaining to the respiratory, circulatory, and digestive systems are either absent or are quite subordinate to those of a neuropathic character. Slowness of the pulse, with or without intermittence, has sometimes been observed, and it is therefore a symptom of some diagnostic value. Toward the close of life both pulse and respiration are usually accelerated. Vomiting, constipation, and retraction of the abdomen, which are so common in meningitis, are only occasional symptoms.

Bronchial Glands.—During the progress of tuberculosis, hyperplasia, cheesy degeneration, and softening of various lymphatic glands may occur throughout the body, but the bronchial and mesenteric are not only those which are most frequently affected, but they are the only glands, unless in exceptional instances, which materially increase the danger or give rise to special symptoms. These symptoms either have a mechanical cause—to wit, the pressure exerted by the enlarged glands on contiguous parts—or they are due to softening of the glands and consecutive inflammation and ulceration.

The following are the principal symptoms due to compression; some of them are not infrequent, others are rare: Compression of the pulmonary veins retards the flow of blood from the lungs to the left auricle, giving rise to congestion and, in extreme cases, œdema of the lungs, with sanguineous extravasation into the lung-substance, congestion of the right cavities of the heart, hepatic veins, and of the systemic capillaries generally. Compression of the pneumogastric nerve or of the recurrent laryngeal, which is the motor nerve of the laryngeal muscles, modifies the voice and produces a cough which is often spasmodic. The cough resembles that of pertussis, and has been mistaken for it, but it is not so violent or protracted. The voice, clear and natural at first, becomes by degrees hoarse or feeble from deficient innervation of the laryngeal muscles.

An enlarged gland or mass of glands lying against the trachea or one of the bronchial tubes (this may occur with tubes up to the third or fourth division), and pressing its walls inward, obviously obstructs more or less the current of air. If there be considerable obstruction, a loud, sonorous râle is produced, which is heard distinctly at a distance from the chest, obscuring other râles. It is loudest when the patient is agitated, and it sometimes intermits. Feeble respiratory murmur, dyspnœa, and a cough are not infrequent in bronchial phthisis. Diminished intensity of the respiratory murmur is general or partial, according to the seat of the compression. It has been most frequently observed at the summit of the lungs. In certain patients this symptom is not constant, the respiration being for a time feeble and then normal. The dyspnœa may be a prominent and distressing symptom, the alæ nasi dilating, and the inframammary region sinking with each respiration. The cough which occurs when a gland presses on the trachea or bronchial tube is due to the tracheitis or bronchitis to which the pressure gives rise. If ulceration occur at the point of pressure, the cough continues as long as the ulcer remains. Compression of the large veins within the thorax which return blood from the head and upper extremities causes more or less congestion of these parts, with, perhaps, transudation of serum in the subcutaneous connective tissue and within the cranium. Rarely, a softened gland by ulceration gives rise to other symptoms than those mentioned—to wit, hemorrhage by ulceration into a vessel or pleuritis or pneumonitis if the ulceration be toward the lungs.

Improvement in the condition of the patient affected with bronchial phthisis is not unusual. It may be permanent, but in most patients it is temporary, so that in a few weeks or months the symptoms are as severe as before. The improvement is due to softening and elimination of a gland which had given rise to symptoms by its mechanical effect or by the inflammation which it had excited.

PHYSICAL SIGNS—*From Tubercular Bronchial Glands.*—These are absent or obscure in the incipient disease when the glands are small, and they are most marked in those cases in which the glands are so large as to press on the thoracic walls, since they then become the medium for the transmission of sounds to the ear. The part of the thorax against which they most frequently press is the dorsal vertebræ from the first to the sixth, and each side of the vertebræ, and less frequently the upper third of the sternum. The physical signs are dulness on percussion over the interscapular space, and perhaps, though to a less extent, over the upper part of the sternum, and bronchial respiration in the same situations. Occasionally a bruit can be detected, due to the pressure of a gland on one of the large vessels of the chest.

Lungs.—A cough is one of the earliest and most persistent of the symptoms of pulmonary tuberculosis. It is so rarely absent that those of large experience do not meet with more than one or two such cases. It varies in severity and frequency. If the tuberculosis be acute and its course rapid, the cough, even from its commencement, is frequent, so as to weary the patient and deprive him of needed rest. But in ordinary cases—that is, when the disease is chronic—it commences gradually, attracting at first little attention by its infrequency, but becoming more frequent and painful as the malady advances.

Ordinarily, the cough is dry in the first weeks or months, but it becomes looser in the course of the disease, from the greater amount of bronchial inflammation. In exceptional instances it has a spasmodic character, like that produced by pressure of an enlarged bronchial gland on the pneumogastric or recurrent laryngeal nerve. This occurs from the accumulation of viscid mucus in one or more of the bronchial tubes, usually in dilated portions of them, from which it is with difficulty expectorated.

The respiration in pulmonary tuberculosis is accelerated in proportion to the degree of tuberculization. Tuberculization of a considerable part of both lungs gives rise to dyspnœa, especially when, as is ordinarily the case, bronchial, pulmonary, or pleuritic inflammation has supervened. Pneumonitis or pleuritis gives rise to the expiratory moan, and as these inflammations, when induced by tubercles, are protracted, this symptom may continue for weeks or months.

Patients under the age of six years do not expectorate, or but rarely. After this age expectoration is not common in the commencement of pulmonary tuberculosis, but in the confirmed disease it is a pretty constant attendant of the cough. Hæmoptysis is also rare under the age of six years, and less frequent subsequently than in the adult. It is most likely to occur in those cases in which there is already passive congestion of the lungs produced by the pressure of enlarged bronchial glands in the manner already described. Patients old enough to express their sensations, sometimes complain of fugitive pains under the sternum or between the shoulders.

In young children the physical signs of incipient pulmonary tuberculosis are wanting, or are so obscure as not to be readily recognized. This is due to the small size and dissemination of the tubercles. In older children the physical signs appear early, and are readily recognized, because, as a rule, the tubercles are aggregated, and are more frequently at the apices of the lungs, as in the adult, than elsewhere. In the advanced disease, whether in infancy or childhood, when inflammation and more or less destruction of the lung-substance have occurred, the physical signs, so far from being obscure, enable us in most cases, in connection with the history, to make an immediate and positive diagnosis.

In young children affected with pulmonary tuberculosis the irregular and imperfect expansion of the lungs produces by degrees changes in the shape of the thorax which are apparent on inspection. In some, the lungs being habitually imperfectly inflated, the obliquity of the ribs is increased, and the thorax consequently elongated, while its antero-posterior and transverse diameters are diminished. This obviously increases the convexity or arch of the diaphragm, so that this muscle sometimes lies against the thoracic walls as high as the ninth or even eighth rib. If the costal cartilages are yielding, there are anterior flattening of the chest and depression of the sternum; if they are firm on account of the more advanced age, the chest remains circular.

Another shape of the thorax is not infrequent in feeble tubercular children, especially infants, who have suffered from repeated attacks of bronchitis. It occurs also in the non-tubercular if the conditions which favor it are present. The conditions are, on the one hand, feebleness of the patient, with diminished force of respiration and impaired resiliency of the ribs, and on the other obstruction by mucus of one or more of the bronchial tubes. Occlusion, more or less complete, of a bronchial tube, and consequent obstruction to the current of air, produce a corresponding degree of collapse in the portion of lung to which the tube leads. The parts which collapse are, in most cases, the lower lobes and the thin anterior margins of the upper lobes. This causes lateral depression of the lower ribs, except such as are pressed outward by the abdominal viscera and an anterior projection of the lower part of the sternum. The shape of the thorax in these cases differs from that in rachitis in the fact that the lateral depression does not extend to the upper ribs, nor does the upper part of the sternum project.

Certain precautions should be observed in examining the chest by percussion and auscultation. The child should sit or recline, with the arms and shoulders in the same position on the two sides, and the axis of the trunk straight. Inclination of the trunk to either side, raising or depressing a shoulder, may produce an appreciable difference in the two sides as regards the physical signs. Percussion of the two sides should be practised at the same stage of respiration. A slight difference in the degree of resonance does not afford proof of disease unless it be observed at different examinations; for in feeble children it often happens that all portions of the lungs do not expand alike, so that where we have noticed slight dulness at one visit, it may by the next have disappeared, or even at the same visit, if forcible inspirations be excited.

The physical signs ascertained by palpation, auscultation, and percussion are, as in the adult, vocal fremitus, bronchial respiration, bronchophony, and dulness on percussion. In those cases in which the tubercles are mainly at the apices of the lungs, diminished expansion of the infraclavicular region is observed during inspiration, and this part of the thoracic wall is permanently depressed, so that the clavicles are unusually prominent. If there be emphysema, this flattening does not occur or is slight. Dulness on percussion, though more frequently observed in the infraclavicular region than elsewhere, may be present in different isolated places. If pneumonia supervene, the dulness not infrequently extends over a considerable part of one lung. The cracked-pot sound is often observed on percussion, but it possesses little diagnostic value. It can be produced when there is no pulmonary disease by percussion over a bronchus.

Bronchial respiration and bronchophony are important signs, as indicating solidification of the lung, but they do not show whether the solidification be tubercular or pneumonic or the two conjoined. This must be determined by the history of the case, the extent of surface over which these signs are heard, and their persistence. When the tubercles begin to soften and the lung-tissue breaks up, moist râles appear, often hoarse and gurgling, obscuring the bronchial respiration. A cavity in the lung, or pneumothorax, is attended by the same physical signs as in the adult.

Pleura.—Little need be said in reference to the symptoms and physical signs of tuberculosis of the pleura, since this affection is in most instances associated with tuberculosis of the lungs, and is not distinguishable from it. But now and then the pleural tubercles are numerous and large, giving rise to symptoms, while those of the lungs are small, few, and without symptoms or attended by symptoms which are quite subordinate. Either the costal or visceral portion of the pleura may be the seat of tubercles. They are developed directly under the pleura or upon its free surface. They may occur in the newly-formed connective tissue which results from pleuritis. Those located upon the free surface or under the costal pleura rarely soften, while those under the visceral pleura sometimes soften and cause ulceration. Occasionally numerous aggregated tubercles form a firm continuous layer upon the surface of the pleura, preventing, if upon the visceral pleura, full expansion of the lung. This may give rise to a degree of dulness on percussion and feebleness of the respiratory murmur. Ordinarily, however, in this form of tuberculosis the symptoms and physical signs, so far as any are observed, are due to the pleuritic inflammation which the tubercles excite.

Stomach and Intestines.—The symptoms in tuberculosis of the stomach and intestines vary according to the seat and stage of the tubercles.

Tubercles, whether gastric or intestinal, are not at first accompanied by symptoms or the symptoms are obscure and ill-defined. Symptoms arise when inflammation occurs in the tissues in which the tubercles are imbedded or upon which they lie, and through their irritating action. Diarrhœa is one of the most common and persistent of the symptoms. The alvine discharges are brown and thin, and sometimes, in advanced cases, very offensive. They may be streaked with blood which has escaped from the ulcers. Intestinal tubercles, developed immediately underneath the peritoneal coat, sometimes cause local peritonitis, usually of little extent. This gives rise to circumscribed pain, tenderness, and more or less meteorism.

DIAGNOSIS.—It is evident from the foregoing description of symptoms that the diagnosis of incipient tuberculosis is much more difficult in children than adults. Before commencing the examination it is best to learn the hereditary tendencies of the family and the history of the patient, especially as regards antecedent diseases or debilitating agencies, and the duration of the symptoms.

Early and accurate diagnosis of tuberculosis in the child, as well as in the adult, is now rendered possible by the discovery of the tubercle bacillus in 1882 by Koch. This bacillus, abounding in the sputum as well as in the affected organs of phthisical patients, having a slender rod-like form, having a length varying from one-fourth to the entire diameter of the red blood-corpuscles, and susceptible of a peculiar staining by the aniline colors which differentiates it from all other bacilli, is, as we have stated above, believed to be uniformly present in tuberculosis and absent in other conditions.

Children with tuberculosis of the lungs expectorate comparatively little, but sufficient sputum can probably be obtained in most instances for the purpose of diagnosis. The presence of the bacillus indicates clearly the tubercular nature of the disease.

Tuberculosis of the encephalon is diagnosticated with more difficulty than that of the thoracic or abdominal organs; but certain of these organs are in most patients tubercular at the same time, and the knowledge of the fact that they are affected aids in the diagnosis of the disease of the brain or its meninges. Among the symptoms of intracranial tuberculosis which possess diagnostic value may be mentioned cephalalgia and more or less fever, with exacerbations in the commencement of the disease, and, at a more advanced period, strabismus, inequality or irregular action of the pupils, impairment of vision, retraction of the head, and convulsive movements or paralysis.

In certain cases careful observation and discrimination of symptoms are requisite in order to determine whether they arise from intracranial tubercles or from congestion of the brain caused by obstruction in the venous circulation by the pressure of enlarged bronchial glands.

The diagnosis of bronchial phthisis, when the glands are still small, is necessarily uncertain, on account of the absence of symptoms. When they have increased in size and are so located as to press on the pneumogastric or recurrent laryngeal nerve, producing the spasmodic cough already described, the differential diagnosis between that disease and pertussis may be made by attention to the following facts: Bronchial phthisis occurs singly and is non-contagious, while pertussis occurs as an epidemic and with evidences of contagion. There are no successive stages—to wit, those of catarrh, paroxysmal cough, and decline—as in that disease, and the cough, though paroxysmal, is short and without whoop or vomiting.

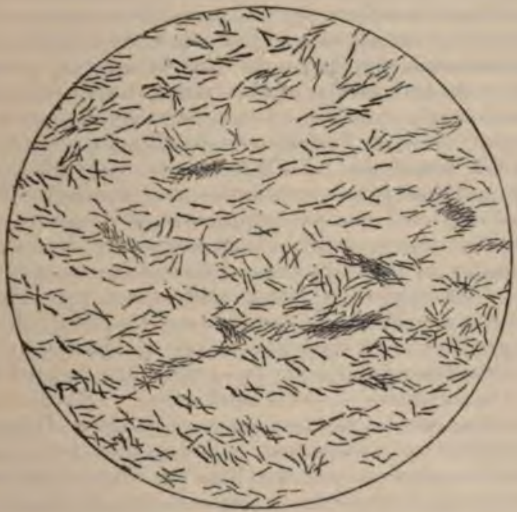
In feeble children with inherited tubercular diathesis, emaciation, sweats, and a chronic cough, with the absence of pulmonary symptoms, should excite suspicions that the bronchial glands are involved. The evidence is almost conclusive if the cough become paroxysmal and there be a loud, persistent tracheal or bronchial râle.

In certain patients affected with this form of tuberculosis we have seen that the prominent symptoms are due to compression of one or more of the large vessels in the chest. Compression of these vessels, and consequent retarded circulation, may be confidently referred to enlarged bronchial glands, since aneurism, carcinomatous or other tumors, which would produce a similar result, are very rare before puberty. Sometimes the diagnosis is rendered certain by the physical signs observed by auscultation and percussion over the sternum and the interscapular space. The condition of the external glands should also be observed, as those of the axilla, neck, and groin.

The diagnosis of pulmonary, though more readily made than that of intracranial and bronchial, tuberculosis is often difficult and uncertain. This is in part explained by the fact that the tubercles are so frequently disseminated, while emaciation and a chronic cough are not infrequent from other causes than tubercles. Rachitis, intestinal worms, dentition, simple tracheal or bronchial inflammation, may be attended both by a chronic cough and emaciation. Caution is therefore requisite in order to avoid a grave error in diagnosis. Precipitancy in the diagnosis of doubtful cases is worse than indecision, and it is often best to postpone an expression of opinion as to the nature of the disease till the case has been observed a few days.

The significance and importance of the symptoms, physical signs, and other facts on which a diagnosis must be based have already been sufficiently pointed out. It is difficult—in fact, in certain cases impossible—to discriminate by the physical signs between simple cheesy pneumonia and cheesy pneumonia which has ended in the formation of tubercles. The patient has an attack of catarrhal pneumonia, but instead of absorption of the inflammatory product, cheesy infiltration occurs, and the lung in places becomes infiltrated with pus, softens, and breaks down. The patient presents the symptoms and physical signs of phthisis. He may recover after a protracted sickness or may die. The disease may remain a pneumonia; but this is a condition of the lungs which favors the development of tubercles, and in a certain proportion of cases tubercles do form in the last weeks of life. Though the differential diagnosis in such cases between cheesy pneumonia and tuberculosis supervening on pneumonia is impossible by the physical signs, practically the discrimination is unimportant, as the same treatment is required. But it is obvious, from the facts now ascertained in reference to the tubercle bacillus, that in all cases of doubtful diagnosis the sputum, if it can be obtained, should be examined microscopically. If the bacillus be present, the diagnosis of tubercular disease may be considered certain.

FIG. 25.



Bacillus tuberculosis (Sternberg).

Advanced pulmonary tuberculosis, except when it supervenes upon pneumonia, can in most instances be readily diagnosticated by auscultation and percussion of the chest. Still, it is to be recollected, as already pointed out, that certain of the symptoms and physical signs, which occurring in the adult would afford almost positive proof of pulmonary tuberculosis, not infrequently have a different origin in children.

The diagnosis of tubercles in the abdominal organs is facilitated by the presence of symptoms which indicate at the same time tuberculosis of the lungs. Among the chief diagnostic signs of tuberculosis of the peritoneum may be mentioned meteorism and a degree of tenderness on pressure, but there is danger of mistaking the tympanitic state of the intestines common in ill-nourished infants and the rachitic, or the fulness due to an enlarged spleen or liver, for that occasioned by peritoneal tuberculization, and *vice versâ*. The history of the case and a careful examination of accompanying symptoms and the shape and feel of the abdomen usually suffice to establish the diagnosis. In simple gaseous distension of the abdomen there is an absence of the symptoms, general and local, which attend tuberculosis; rachitis occurs at an earlier age than peritoneal tuberculosis, and digital examination, aided by percussion, enables us to diagnosticate enlargement of the liver or spleen.

Tubercular enlargement of the mesenteric glands cannot be positively diagnosticated when they are small. When they have attained such a size that they can be felt through the abdominal walls, palpation, in connection with the history and symptoms of tuberculosis, suffices to establish the diagnosis. Enlarged and tubercular mesenteric glands can be diagnosticated from other tumors by the fact that they are tender on pressure and occupy the umbilical region. Fecal accumulations, from which they are to be diagnosticated, are located in the iliac or lumbar region. Gastro-intestinal tuberculosis cannot be positively diagnosticated. Protracted diarrhœa or frequent attacks of diarrhœa, not readily controlled by medicine and occurring in tubercular cases, are probably associated with intestinal ulceration.

PROGNOSIS.—It has long been the belief in the profession, as well as among the laity, that tuberculosis is in the end, with few exceptions, fatal, whatever remedial measures are employed, and that, therefore, remedies may ameliorate symptoms, but do not change the result. But since attention has been directed to this subject a sufficient number of observations have been made to show that tuberculosis at an early stage can in a considerable number of cases be cured or rendered latent. The late Professor Austin Flint, in his treatise on *Phthisis*, published in 1875, stated that of 670 phthisical cases which came under his observation, he ascertained by auscultation and percussion that the disease had been cured in 44 and was non-progressive in 31 others. But the most convincing proof of the curability of tuberculosis is furnished by the post-mortem examination of those who have died of other diseases. A cretaceous or fibroid state of the apex of the lung, without tubercles elsewhere, may be regarded as certain evidence of arrested tuberculosis. Now, two of the curators of large New York hospitals inform me that they frequently find cretaceous or fibroid degeneration at the apex of the lung, without tubercles elsewhere, in the autopsies in these institutions. One of these gentlemen, whose examinations are in the dead-house of Bellevue Hospital, states that this evidence of arrested tuberculosis is present in at least one-fourth of the cadavers which he examines, and the Bellevue Hospital patients come from the most crowded and insalubrious tenement-houses of the city, and have led a life of poverty and privation, and frequently of dissipation. The *London Lancet* (September 22, 1888) states that M. Vibert has examined the records of the necropsies in the Paris Morgue, and that in 131 subjects whose death had been sudden from violence or acute diseases, the lesions of pulmonary tuberculosis were present in 25, and in 17 of these the tubercles had undergone the cretaceous or fibroid change, and were practically cured. It is certain, therefore, that tuberculosis of the adult in its commencement, and when affecting only a small portion of the lung, is often cured or rendered permanently latent.

It is now known that ordinary serum circulating in the blood-vessels possesses marked germicidal properties, and therefore measures which benefit the general health and improve the quality of this important constituent of the blood have a curative effect as regards tuberculosis. The tubercle bacillus is an irritant to the tissues, and in cases which are cured or rendered latent it becomes surrounded by dense tissue which in time undergoes the cretaceous or fibroid degeneration. The bacilli in the interior of the mass may retain their vitality for an indefinite time, but, being encapsulated, they do no harm. There can be no doubt that many adults have local tuberculosis, and are cured by improvement in their general health and in the quality of their blood, without suspecting that they have had this disease. In young children, especially in infants, tubercles are frequently disseminated in the organs, and recovery under such circumstances must be impossible or rare; but local tuberculosis or tuberculosis limited to certain glands, as the bronchial, is not unusual in childhood, and this form of the tubercular disease may be cured by measures which improve the general health.

Hospital statistics show that the average duration of the disease is from three to seven months. Under favorable circumstances it is more protracted, even to two or three years. Those succumb soonest who inherit a strongly-marked tubercular diathesis, live in damp, dark, and ill-ventilated apartments, and whose diet is scanty or of poor quality. Therefore in the poor quarters of the city tuberculosis presents a worse form and pursues a more rapid course than among families in better circumstances.

Favorable prognostic signs are absence of tubercular diathesis, good appetite and general health, with little emaciation, infrequency of cough, with respiration, pulse, and temperature nearly normal. Such symptoms may afford hope of recovery with judicious regimenal and therapeutic measures. On the other hand, if the symptoms be grave death is inevitable, unless in bronchial phthisis, in which, even when there is considerable urgency of symptoms, the offending gland is sometimes eliminated by softening and ulceration, and the patient improves temporarily, if he do not ultimately recover. Complete and permanent recovery is, however, quite exceptional in bronchial phthisis, as it is in other forms of the disease. As Liebermeister has said, recovery in any form of tuberculosis is impossible except in incipient and very limited forms of the disease.

Death in tuberculosis of children may occur from exhaustion induced by the general disease or from the local effects of the tubercles. Thus, in intracranial tuberculosis it may result from meningitis ending in convulsions and coma; in pulmonary tuberculosis, from dyspnœa, though more frequently from exhaustion; in that of the bronchial glands, from dyspnœa or hemorrhage; in that of the abdominal organs, from peritonitis or protracted diarrhœa.

PROPHYLAXIS.—Since tuberculosis originates in so many different ways, measures designed to prevent this disease have a wide range. Precautionary measures are especially required in the nursing of the tuberculous patient. His sputum should always be received in a cup or spittoon containing a disinfectant liquid, and this vessel when emptied should be cleansed with boiling water or a disinfectant. Sputum should never be received upon a handkerchief or cloth and allowed to dry. Towels and handkerchiefs should be moist when used, and immediately afterward placed in boiling water or a disinfectant. We have seen what disastrous results occur from the dried sputum. Whatever may be said of the innocuousness of the breath of the phthisical patient, based on the supposition that the tubercle bacillus has so great a specific gravity in its moist state that it is not exhaled in ordinary respiration, nevertheless the sad experience of the midwife related in a foregoing page should teach us to avoid his breath, so far as is compatible with proper ministrations to him. The floors and walls of his apartment should occasionally be washed with a disinfectant fluid, and the bedding, clothing, rugs, and mats should never be shaken in the apartment, but outside the house. Ventilation of the apartment should be allowed to the full extent compatible with the safety of the patient. The remedies which we will hereafter recommend in the treatment of the patient are destructive to the bacillus, and therefore whenever employed have also a prophylactic action.

No physician who has read in the medical journals of the last decade the many reports of cases in which milk has been the vehicle of pathogenic organisms has failed to see the urgent need of obtaining this indispensable article from healthy dairies. Families should insist on the inspection at regular intervals of the dairies that furnish them milk, and the exclusion of such animals as exhibit the least sickness. Moreover, no one with a chronic cough should be employed in milking or in the subsequent handling of the milk. But with the utmost endeavor, on the part of families living at a distance, to obtain milk free from impurities, no one can state positively that it will not sooner or later contain pathogenic organisms, as those of diphtheria, scarlet fever, typhoid fever, or tuberculosis, so many and unsuspected are the modes of infection. Fortunately, heat at or near the boiling-point is an effectual sterilizing agent, and it can be employed without diminishing the nutritive properties of milk or rendering it more indigestible. I do not forget the interesting experiments which have been made to determine the tenacity of life of the tubercle bacillus when subjected to heat and cold. In experiments made it is said to outlive most of the microbes associated with it. Schill and Fischer state that dried and pulverized tubercular matter not subjected to treatment retains its virulence six months, and Pietro states that tubercular sputum well dried and maintained at 77° retains its virulence nine or ten months. But what concerns us most at present is the remarkable statement made by Max Voelsch (*Centralb. für klin. Med.*, June 30, 1888), that twice boiling does not entirely destroy the virulence of the tubercle bacillus. I habitually direct that the morning supply of milk designed for children shall be immediately placed in a steamer and subjected for two hours to a temperature of 190° to 200°. No pathogenic microbe can probably survive if subjected so long a time to so high a degree of heat. The flesh of the tubercular animal, which it is believed is often purchased by unsuspecting families, evidently requires similar treatment—that is, thorough cooking—in order to be rendered innocuous. A competent meat inspector should be employed at each slaughter-house, and all diseased meats be rejected; but in the present management of the meat market the only sure method of preventing the presence of living and active bacilli in the meat foods appears to be by thorough cooking.

Outdoor life, residence in elevated localities, where the air is not only pure but rarefied, the occupancy of sunlit and well-ventilated rooms, the avoidance of rooms or localities where the air is contaminated by the presence of others, as in crowded schools or factories, or by unwholesome occupations, and all measures which promote the appetite and general health, are prophylactic, as they are also to a certain extent curative, of tuberculosis. It is evident, from what has been stated above, that caseous substance occurring in any part of the system, inasmuch as it sustains a close causal relation to tuberculosis, should, if practicable, be removed by surgical measures. Moreover, since cheesy degeneration results for the most part from inflammations occurring in the scrofulous, measures designed to prevent or cure such inflammations or to cure scrofula have a prophylactic effect as regards tuberculosis. The strumous child should be watched with great care, and such measures be employed as are calculated to invigorate his system. He should receive antistrumous treatment, both hygienic and medicinal. Especially should glandular hyperplasia and the products of inflammation, whether occurring in the lungs or elsewhere, be, if possible, removed before caseation occurs. For this purpose the old remedies, like cod-liver oil and syrup of the iodide of iron, given internally, and for hyperplasia of the subcutaneous glands ointments like iodide of potassium in lanolin, may be advantageously employed. Finally, one having an abrasion or sore of the cutaneous or mucous surface, or catarrh of the air-passages, as indicated by discharge from the nostrils, sore throat, or a cough, should not attend as nurse or otherwise a phthisical patient until his local ailment is cured, since the tubercle bacillus is believed to enter the system more readily through a diseased than a healthy surface.

TREATMENT.—The indications of treatment are twofold: first, to invigorate the system in every possible way, so that the organs and tissues are in a better condition to resist the bacillus and the serum to antagonize and destroy it; and, secondly, the employment of medicinal agents, if such can be found, which are destructive to the bacillus and safe to the patient.

Measures designed to improve the general health must be chiefly hygienic, and are described in all the text-books. The diet should consist of milk, the meat preparations, and farinaceous substances, prepared in such a way that they afford the maximum amount of nutriment and are easily digested. If the digestion be poor, peptonized food may be advantageously employed, and pepsin may be taken with the food. In 1881–82, Debove recommended gavage or forced feeding of consumptives through a flexible rubber tube having a funnel attachment, the tube being introduced into the stomach. He employed meat preparations, with pepsin. In the *Medical News*, October 1, 1887, Dr. S. Solis-Cohen of Philadelphia also recommended gavage in the treatment of phthisis. A quart of milk, two tablespoonfuls of beef powder, three eggs, fifteen grains of scale pepsin, and thirty drops of dilute muriatic acid were warmed and administered twice daily through a stomach-tube, a patient eating what he wished in the interval. Gavage has been employed by certain European physicians in the treatment of children suffering from various forms of innutrition, and it seems probable that tubercular patients may be benefited by it in some instances. In the ordinary mode of feeding the predigested foods can often be used with benefit by consumptives, inasmuch as they have, for the most part, feeble digestion.

As regards the hygienic measures designed to arrest tuberculosis, the most important, next to the use of proper food and the employment of such aids to nutrition as cod-liver oil and the alcoholic preparations, is outdoor life, and, if possible, in localities having a high altitude. The late Professor Flint, in examining the records of 62 cases of arrested phthisis which came under his observation, ascertained that the principal agent in affecting this result was exercise in the open air. He therefore strongly recommended this mode of life to consumptives, and also constant ventilation of their sleeping apartments, even in the winter season, the danger of taking cold being averted by maintaining sufficient warmth of air by a fire. Dr. James Blake has also reported instances of recovery of phthisical patients who lived during the five or six months of the dry season in the open air upon the Coast Range of mountains in California at an altitude of 3000 to 5000 feet. These patients were in the open air night and day, without even the protection of tents.

Residence at a High Altitude.—The *London Lancet*, May 26, 1888, contains the abstract of a paper read before the Medico-Chirurgical Society of London by Dr. Williams, recommending residence at a high altitude as an efficient means of checking the progress of tuberculosis. He states that of 141 patients who had employed the high-altitude treatment, 14.13 per cent. were completely cured, 29.78 per cent. were much benefited, 11.34 per cent.

were more or less benefited, and 17.02 per cent., including 13.47 per cent. who died, continued to grow worse. Drs. Quain and Pollock, in discussing this paper, expressed the opinion that consumptives who improve at a high altitude improve equally with the same treatment at lower elevations; in other words, that residence at a high altitude does not influence the result. Brehmer, on the other hand, believes that the inhabitants have immunity from tuberculosis at an altitude of 1500 feet in Germany, of 4500 to 5000 feet in Switzerland, and 10,000 to 15,000 feet at the equator (*Die Therapie Chronische Lungenbeschwerden*, Wiesb., 1887). The most apparent and notable peculiarity in the air at high elevations, apart from its purity, is its rarefaction. At an altitude of 9000 feet above the level of the sea it is said, from observations made, that the air is so rarefied that three times the usual exercise of the lungs is required to meet the demands of the system. Dr. Mays states in a paper published in the *Medical News*, November 27, 1886, that the Quichua Indians, on the lofty plateaus of Peru, constantly breathing a rarefied air, "acquire enormous dimensions" of the chest, due to an increase in the size, and perhaps number, of the air-cells. More numerous and more exact observations are required in order to determine whether or to what extent residence at a high altitude is beneficial to consumptives, and, if it exerts a controlling effect on the disease, whether this result is due to the increased pulmonary expansion and activity or to other causes. Certainly, from observations already made, we are justified in recommending outdoor life in a mild and equable climate, and also residence at high elevations if the cold is not too severe.

Residence in the Evergreen Forests and the Use of Turpentine.—In an interesting paper read before one of the societies, and subsequently published, Dr. A. L. Loomis states his belief that the terebinthinate vapors in the evergreen forests possess healing properties for consumptives. He quotes the statement of Ringer that turpentine employed as a medicine enters the blood, and may be detected in the breath, the perspiration, and in an altered form in the urine of the patient. The presence of the vapor of turpentine in the pine forest, Dr. Loomis remarks, cannot be doubted, and its "local and constitutional effects," he adds, "are those of a powerful germicide as well as stimulant." Dr. Loomis quotes the opinion of Mr. Kingsett that turpentine, during its oxidation, evolves the peroxide of hydrogen, and therefore by the "oxidation of the terebinthinates there is produced in extensive pine forests an almost illimitable amount of peroxide of hydrogen, which renders the atmospheres of such forests antiseptic." He believes that the peroxide of hydrogen so abundantly produced in pine forests "successfully arrests putrefactive processes and septic poisoning," and therefore he recommends residence in the pine forests as one of the most efficient means of relieving the symptoms of tuberculosis and retarding the progress of this fatal malady. At high altitudes the coniferous or evergreen trees usually predominate, and if the views of Professor Loomis be substantiated by future investigations, it may be that the benefit believed to be obtained by consumptives at high elevations is partly due to the exhalations from these trees.

The bacteriologists who have cultivated the tubercle bacillus, and observed the action upon it of the various agents which have been employed and extolled by clinical observers, state that most of these agents do not penetrate the tubercular mass—that while they may destroy the superficial bacilli, they do not affect those more deeply seated, and therefore fail to arrest the disease. But turpentine and its derivatives appear to penetrate the tissues as deeply as almost any other agent, and therefore, if they are sufficiently antiseptic and not too irritating, we may expect good results from their judicious use. But it is probable that they are less efficient as germicides than some of the other agents which can be safely employed, and therefore should be recommended only as adjuvants, or as remedies which may give some relief to the catarrhal and other symptoms without exerting any marked antiseptic action. Hohnfeld states that he applied oil of turpentine to fresh colonies of the micrococcus prodigiosus and staphylococcus aureus, and that it exerted little destructive or retarding effect on these micro-organisms.[1] These experiments would lead us to distrust the germicide action of turpentine and the terebinthinate preparations in tuberculosis, for the tubercle bacillus is tenacious of life beyond most other microbes. But the alleged good results of teaspoonful doses of the oil of turpentine in that other microbic disease, diphtheria, certainly justify the experimental use of the agent in tuberculosis.

Terebene, produced by the action of gaseous hydrochloric acid on turpentine, has been prescribed in tuberculosis and chronic bronchial catarrhs, with some apparent benefit. An adult should take ten, increased to twenty, drops three times daily. A child can take a dose proportionate to the age. The following formula has been recommended:

℞.	Terebene,	ʒiv;
	Pulv. acaciæ,	℥iij;
	Aquæ,	℥ij;
	Syr. zingiberis,	℥j. M.

Dose: One teaspoonful three times daily for an adult; a dose proportionate to the age for children.

Terebene can also be employed in inhalation from Robinson's inhaler, or, properly diluted, from the hand- or steam-atomizer. It has been administered in ten-drop doses to some of the adult consumptives in my wards in the Charity Hospital, and the resident physician who had charge of these cases writes me as follows: "I am satisfied that in nearly all cases of dyspnœa it is of value. In some it affords marked relief, and I have had patients tell me that it gave the most relief of anything. Others say that it afforded some relief. It makes expectoration in some patients markedly more easy and the sputum much thinner; in others the effect is only slight or moderate." It probably aids in relieving the catarrh which accompanies tuberculosis.

Hot-air Inhalations.—Halter states that workers in a limekiln, breathing dry air at a temperature of 122° to 156° F., were exempt from phthisis during a period of fifteen years in a locality where this disease was common. He also states that the most favorable temperature for the growth of the bacilli is 98.6° to 104° F., and that a temperature of 105.8° destroys them. Moreover, his experiments have shown him that the inhalation of dry air at a temperature of 248° to 256° raises the temperature of the expired air to about 109.7°—a degree of heat which, he says, is fatal to the bacillus.[2] Dr. E. Krull states that for more than two years he has treated consumptives with the inhalation of hot air heated to 132° F., and that this raised the temperature of the expired air to not less than 107.6°, and incipient cases seemed to derive benefit from this treatment. Dr. Weigert of Berlin has constructed an apparatus for the inhalation of hot air which was employed for a time in the wards of Charity Hospital, but it did not seem to give as much relief as the antiseptic inhalations which have been used by the same patients.

Dr. Trudeau of Saranac Lake prescribed the hot-air treatment in four cases four hours each day, the temperature of the inhaled air being 392° F. The first and second patients improved slightly at first, but refused the treatment, the one after one month, and the other after six weeks. The third patient was treated three months without the least appreciable effect. The fourth patient was treated four months, with manifest improvement in her physical signs and general health, but no more improvement than frequently occurs from any new mode of treatment. In all the cases the sputum was examined before, during, and after the treatment, and in every examination the tubercle bacillus was present. The result claimed for the hot-air treatment had not been obtained—that is, the destruction of the bacilli; and if they are not destroyed in the sputum, certainly they are not in the tissue of the lung. Therefore there can be little doubt that the hot-air inhalations, so far from coming into general use, will be discarded, not only because they are unpleasant to the patient, but are inefficient. There is always a large amount of residual air in the alveoli, and there can be little doubt that in the hot-air inhalations the air in the alveoli and terminal bronchial tubes never attains the elevation of temperature of the air that is inhaled, nor of that which is exhaled. Moreover, as we have seen, the tubercle bacillus resists the destructive action of high temperature. It is said to retain its vitality in liquids which have been twice heated to the boiling-point.

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[1] *Fortschritte der Medicin*, October 1, 1887.

[2] *Berliner klinische Wochenschrift*, September 3, 1888.

Creasote.—Of the many medicines which have been recently employed in the treatment of tuberculosis, creasote appears to have given more general satisfaction than any other. I am informed that the late Dr. Cammann, the inventor of the binaural stethoscope, employed it twenty years ago in the treatment of tuberculosis, but it was seldom prescribed for this disease until within the last decade. In the *Berliner klinische Wochenschrift*, July 20, 1886, Von Brunn states that he has treated 1700 phthisical patients in the last eight years with creasote, giving to adults not less than six to eight drops in twenty-four hours. He employed it in solution with tincture of gentian and wine, and believes that he obtained good results, especially in acute unilateral cases. Professor Sommerbrodt states[1] that he employed creasote in about 5000 phthisical cases during the preceding nine years. At first he used Bouchard's solution of creasote, and afterward gelatin capsules, each containing three-fourths of a grain of creasote and three minims of the balsam of Tolu. The amount of creasote administered daily to the patients who were adults was increased gradually from one capsule to not less than nine. As many as 600 to 2000 capsules were given to each patient without a break. In many cases the improvement was marked, not only in the symptoms and in the general health, but also in the physical signs. He believes that he has cured cases by insisting on a continuance of the treatment. To show the good effect of creasote, he cites the case of a student of sixteen years, with tuberculosis of the right lung, who took three capsules three times daily, or about seven and a half grains per diem. His cough abated, his weight increased six pounds in two months, his expectoration had ceased. Instead of the dull percussion sound over the apex of the right lung, only a slight rhonchus was observed, and his general health had greatly improved.

Many others who have employed creasote during the last two or three years, both in this country and in Europe, report favorable results. Strümpell says that it produces no ill effects, and in large doses it frequently causes improvement in such symptoms as the cough, expectoration, and appetite, but he doubts whether it exerts any marked curative effect upon the disease. It has been employed during the last year in Charity Hospital, and the resident physician who had charge of the ward in which it was used writes to me that it "seems to possess some staying influence over the progress of the disease." In the New York Foundling Asylum creasote in cod-liver oil has been administered during the last year to the few phthisical patients under treatment, in doses of one drop three or four times daily to children of three or four years, and Dr. Lynde, the resident physician, thinks that it has been the most useful of the remedies employed.

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[1] *Medical Chronicle*, July, 1887.

During the past year I have prescribed creasote for internal use in the following formula:

℞. Creasoti (Morson's),
Spiriti chloroformi,
Alcoholis, āā. ℥ss. M.

Dose for an adult, nine drops three times daily in half a teacupful of water containing a tablespoonful of brandy or two tablespoonfuls of wine. The nine drops of the mixture, containing three of the creasote, have been increased to twelve drops, or four of creasote, and thus far in my practice patients believe that they have been benefited by this remedy, and have desired to continue it. At the same time, in some instances I have recommended the inhalation of ten or fifteen drops of the same mixture from Robinson's inhaler. This dose of creasote, three or four drops, may seem large, but it is tolerated when sufficiently diluted, though it may be best to commence with a smaller quantity. Children should of course take doses proportionate to the age, the fractional part of a drop being sufficient for infants. Creasote has also been injected into the tubercular lung through the chest-walls by several physicians, a syringe provided with a long and delicate needle being used. Rosenbusch injected eight drops of a 3 per cent. solution of creasote in almond oil in two places at the seat of the disease, or sixteen drops in all. The result was a marked diminution of the cough, the sweats, the amount of sputum, and, in recent cases, an increase in weight. The beech creasote was used, and the skin and apparatus were first sterilized by an antiseptic lotion. When the instrument was not introduced deeply enough, a sharp, pleuritic pain sometimes occurred, but it soon abated. Creasote appears to be the most valuable of the recent remedies recommended for tuberculosis, but in order to determine its exact value, the proper mode of employing it, and the size and frequency of the dose, more extended observations are required. Fräntzel says that experiments have shown that this substance is inimical to the growth of the bacillus when mingled in minute quantity with a gelatin culture-medium, and on this fact is based its internal administration. When it is injected into the lungs through the chest-walls, Dr. E. G. Janeway of New York believes that it is very important that the almond oil or other vehicle employed should be first sterilized.

In the present state of our knowledge of the use of antiseptics in the treatment of tuberculosis creasote is the one which is most deserving of confidence and employment. In New York City, in the present epidemic of measles, in cases of protracted broncho-pneumonia with emaciation, the symptoms indicating the probability of cheesy degeneration and commencing tuberculosis, the patients being young children, I am prescribing the hourly inhalation of the vapor of creasote, one part to ten or fifteen of terebene, fifteen to twenty-five minims of the mixture being dropped on blotting-paper in the bottom of a teacup. Children willingly inhale this vapor five or ten minutes at a time, with some apparent relief of symptoms. At the same time, I employ creasote internally if marked symptoms of tuberculosis appear. The following prescription has been considerably employed:

℞. Creasote, ♏31;
Tinc. gentian., ♏72;
Alcohol, ʒx;
Tokay or Malaga wine, ℥v. Misce.

Dose: One teaspoonful three times daily to an adult; a dose proportionate to the age for a child.

Iodoform.—This agent, dissolved in ether and inhaled, has been recommended. It apparently gives some relief to the cough, and possibly to other symptoms, but the belief that it is destructive to the bacillus has been shown to be fallacious by the experiments of Roosing, who inoculated the eye of a rabbit with tubercular matter mixed with iodoform, and the iodoform did not prevent or retard, but apparently accelerated, the development of tubercle at the point of inoculation by its irritating effect upon the eye.[1] Iodoform cannot, therefore, be recommended as a curative agent in tuberculosis.

Biniodide of Mercury, Corrosive Sublimate.—Miguel and Rueff employed a solution of biniodide of mercury, 1 part to 40,000, as a germicide spray in tuberculosis. They state that of 27 patients treated by this spray, 19 improved and the remaining 8 were neither made better nor worse. It is unfortunate that the results of treatment by the biniodide, as observed by these physicians, were not stated more in detail. If they relied entirely on the opinions of the patients, they may have been deceived, for patients with chronic diseases often believe for a time that they are benefited by new modes of treatment when there is no actual improvement.

The fact that corrosive sublimate, employed internally and locally in the treatment of diphtheria, has the confidence of the profession as an efficient germicide suggests its use in the treatment of other microbic maladies. Moreover, its use in diphtheria has shown us what doses of this powerful agent can be safely prescribed. I am not aware that corrosive sublimate has been employed internally in the treatment of tubercular patients, but it has been used as a spray. In the Charity Hospital several of the patients inhaled from the atomizer one teaspoonful of an aqueous solution of corrosive sublimate, two grains to the pint, every three to six hours, and both the patients and house-physicians believe that it acts beneficially in relieving symptoms, especially the cough. It cannot be doubted that the spray employed as often as every third hour disinfects the sputum to a great extent, and destroys the bacilli upon the surface of the larynx, bronchial tubes, and in the alveoli, but whether benefit may accrue to consumptives from its internal use we have not sufficient data for determining.

Another medicine which has been considerably employed in Europe, and in regard to which opposite opinions are expressed, is hydrofluoric acid. MM. Seiler and Garcin of Paris detailed the results of their use of this agent in a paper published in 1887 in the *Bulletin de l'Académie de Médecine.* They state that of 100 tubercular patients treated by hydrofluoric acid, 35 were cured, 41 exhibited more or less improvement in symptoms, 14 were not benefited, and 10 died. They state that in the favorable cases rapid improvement was observed in the symptoms, such as the fever, night-sweats, dyspnœa, and expectoration. Giacomi of Berne employed a mixture of 100 grammes of hydrofluoric acid with 300 grammes of water in a vessel over a spirit-lamp: 8 patients inhaled the vapor one hour each day. In 1 marked relief occurred; in another some temporary improvement took place as regards the appetite and dyspnœa, but in the remaining 6 the result was negative. No discomfort resulted from the inhalation, though from the well-known action of hydrofluoric acid the window-panes became more or less opaque. Gager has treated 17 cases with the vapor of hydrofluoric acid with the following result: In 5 the bacilli disappeared from the sputum and the auscultatory signs improved in a marked degree; in 7 some improvement in the physical signs occurred; in 12 the weight increased; in 5 cases no result.[2] Grancher and Chautard experimented with hydrofluoric acid on rabbits, and they express the opinion that the vapor of this agent does not penetrate sufficiently to destroy bacilli in the depth of the tissues. Trudeau states that the vapor of hydrofluoric acid is efficient as an antiseptic, and seems to possess greater penetrability than the ordinary antiseptic sprays; but it can only destroy those bacilli with which the inhaled vapor comes in contact; therefore, the bacilli imbedded in the tubercular nodules and the tissues escape.[1] Professor Jaccoud inoculated guinea-pigs with tubercular sputum which had been subjected to the action of hydrofluoric acid, and produced tuberculosis with this sputum as certainly as with sputum not thus treated. From these experiments and others performed under his direction Jaccoud believes that the vapor of hydrofluoric acid, employed in any safe manner, does not destroy the tubercle bacillus or notably diminish its virulence.[2] Therefore, the good effects from the use of this medicine claimed for it by those who first employed it have not been realized in the practice of more recent observers, so that we cannot recommend its employment in the place of remedies which have produced favorable results.

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[1] *London Lancet*, January 21, 1888.

[2] *Deutsche medicinishe Wochenschrift*, 1888, p. 597.

Rectal Injections of Sulphuretted Hydrogen.—This treatment was first employed by Dr. Bergeon of Lyons, and, being highly recommended by him, has been prescribed by many physicians in Europe and America. Its real value has now been apparently fully ascertained. The history of its use is instructive, since it shows how a mode of treatment which is inert may gain the confidence of intelligent physicians. The *British Medical Journal*, May 21, 1887, states that Dr. S. Cayhill of the Isle of Wight has employed Bergeon's treatment in private and hospital practice with the most encouraging results. He believes it is the greatest advance ever made in the therapeutics of pulmonary diseases. Dr. Henry Bennet also notices favorably Bergeon's treatment in the same journal for December, 1886. The late Dr. Bruen of the University of Pennsylvania treated 25 cases by Bergeon's method, employing twice daily from three quarts to a gallon of the gas slowly introduced. In nearly all the cases the night-sweats ceased, the cough, expectoration, and frequency of the pulse diminished, and the temperature fell half a degree to one degree.

On the other hand, Drs. Shattuck and Jackson of Boston employed Bergeon's treatment in 7 cases. No odor of the gas could be detected in the breath of these patients after its use, and paper moistened with a solution of the acetate of lead was not blackened when held before the mouth. The only result which might be attributed to the enemata was some diminution in the expectoration. Professor Austin Flint has made experiments in order to determine whether sulphuretted hydrogen introduced per rectum or by subcutaneous injection enters the lungs. He tested the expired air by holding before the mouth white filter-paper, moistened with a solution of acetate of lead. He ascertained that sulphuretted hydrogen was not exhaled at all, or was exhaled in small quantity and for a period not exceeding three minutes. The presumption is, therefore, strong that sulphuretted hydrogen employed per rectum or subcutaneously in some instances does not enter the lungs, and in other instances enters them in small quantity and is quickly expelled. Dr. Grauer placed cultures of the tubercle bacillus as well as of other pathogenic germs in test-tubes, and subjected them to a current of sulphuretted hydrogen from two hours to a longer time, and yet their vitality was preserved, so that successful inoculations or cultures were produced. Dr. E. C. Trudeau of Saranac Lake says that in May, 1887, a tube containing a pure culture of the tubercle bacillus was subjected for thirty minutes to a stream of undiluted sulphuretted hydrogen made from sulphide of iron and sulphuric acid. The conducting tube was pushed through the cotton and held within half an inch of the coagulated serum, and the jet of gas allowed to play freely on the bacilli upon its surface. The entire mass soon became so blackened by the action of the sulphur as to resemble dark-gray paint. The microbes thus treated were then mixed with the sterilized water and injected into the pleural cavites of two full-grown rabbits. These animals were then placed in a large box, well fed, and kept under a shed in the open air all summer. On October 19th, one hundred and sixty-two days after the inoculation, both rabbits died within two hours of each other, and both were found to have cheesy bronchial glands and advanced pulmonary tuberculosis. The benefit, therefore, supposed by some to be derived from Bergeon's treatment is probably due to hygienic measures.

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[1] *Medical News*, May 5, 1888.

[2] *London Lancet*, November 10, 1888.

Sulphurous Acid.—Dr. Dariex, in a monograph published in the *Bulletin général de Thérapeutique*, February 29, 1888, states that Galen, in the second century, recommended the sulphurous air of volcanoes for consumptives. In recent times attention has been drawn to the beneficial effects of the inhalation of sulphurous vapors in tuberculosis by M. Salland, an army surgeon. A sergeant having this disease, which was progressing notwithstanding active medication, was placed in charge of the rooms in the barracks in which sulphur was burned for disinfecting purposes. This service obliged him to pass nine hours each day in a sulphurous atmosphere. At the end of sixty-five days he was cured. M. Auriol, having observed the good effect of the inhalation of sulphurous acid upon certain consumptives whose occupation compelled them to live in an atmosphere charged with this gas, fitted up a room for the treatment of this disease. The flowers of sulphur, slightly moistened with alcohol, was burnt in the corner of the room. Soon the patient began to have paroxysms of coughing, but he did not leave the room until moistened test-paper began to redden; if the respiration was much oppressed, he left the room sooner or the window was opened. In order to render the vapor less irritating and the paroxysms of coughing less severe, a little benzoin or powdered opium was added to the sulphur. These inhalations were practised morning and evening, the patient fasting and afterward exercising in the open air. Appropriate medication, according to the symptoms, completed the treatment. Seventy patients, at different stages of tuberculosis, were subjected by M. Auriol to the inhalation of the sulphur vapor. Their sputa, previously examined, contained bacilli, and, inoculated in the guinea-pig, caused phthisis in a short time. Thirty of these patients, who were in incipient tuberculosis, obtained an arrest of the progress of the disease, disappearance of the fever and sweats, return of the appetite, and increase in weight. The bacilli disappeared from the sputum. M. Auriol believes that these cases are cured, since the improvement has continued more than two years. The tubercles, he thinks, are transformed into fibrous tissue. Twenty others of the seventy tubercular cases did not have this treatment long enough to determine its value, or received it in an irregular manner. Nevertheless, they stated that they derived benefit from it. The remaining 20 had general tuberculosis and succumbed to the disease. M. Auriol employed sulphurous acid in the treatment of guinea-pigs that were rendered tuberculous by inoculation. They improved in flesh and weight, and in those that were killed a considerable time afterward the tubercular nodules were found to be transformed wholly or chiefly into fibrous tissue.

M. Dujardin-Beaumetz has constructed a very ingenious and simple lamp for producing sulphurous acid by burning the bisulphide of carbon. This produces 111.3 volumes of carbonic acid and 141.4 volumes of sulphurous acid. The carbonic acid does not seem to produce any injurious effect, but, on the other hand, its anæsthetic action increases the tolerance and diminishes the irritation of the sulphurous acid. The *Bulletin général de Thérapeutique*, February 29, 1888, contains a full description of Dujardin-Beaumetz's apparatus which is too lengthy for insertion here.

I have described in the foregoing pages the most important of the remedies which have been recently recommended by apparently competant observers. There are others which, from their nature and the limited trial which they have received, I have not thought of sufficient importance to require notice. Most of them will probably soon be discarded by those who now recommend them. The hygienic measures—as outdoor life, residence at a high altitude, free ventilation of sleeping apartment, and the use of the most nutritious and easily-digested food—still maintain a most important place in the treatment of tuberculosis. Of the medicines, creasote used internally and by inhalation, the inhalation of sulphurous acid vapor, not carried to the extent of irritating the air-passages, and the use of germicide sprays, as of corrosive sublimate, the terebinthinate vapors, etc., appear to be the most deserving of recommendation. But no doubt the next ten years will witness important changes in the treatment of tuberculosis based on its microbic nature, and probably remedies not now heard of will come into use.

CHAPTER IV.

SYPHILIS.

SYPHILIS in infancy and childhood occurs under two forms—to wit, the congenital and acquired. The former is the more frequent.

ETIOLOGY.—Congenital syphilis may be derived from either father or mother. Either parent, having syphilis in its first or second stage, may transmit it to the offspring, although at the time free from syphilitic symptoms. The mother, healthy at the time of conception and contracting syphilis prior to the eighth month of gestation, may communicate the disease to the fœtus. Syphilis contracted by the mother in the eighth or ninth month of gestation is less likely to be communicated to the fœtus. Writers mention the case reported by Zeissel, in which the wife, previously well, contracted syphilis from her husband between the fifth and seventh months of gestation, and the infant, born at term, soon exhibited the characteristic syphilitic lesions. If both parents have syphilis at the time of conception, the infant is almost necessarily syphilitic; on the other hand, if only one parent be syphilitic, the infant may or may not be contaminated. Sometimes with such parentage a part of the children are syphilitic and a part healthy.

All syphilographers agree that syphilis in its third stage is not transmissible from parent to child, but parents in this stage of the disease are likely to beget scrofulous children. Hutchinson of London regards syphilis as an exanthem, with its periods of efflorescence and decline, and the symptoms and ailments which characterize the so-called third stage he regards as sequelæ. That syphilis is no longer transmissible after the close of the second stage is shown by many observations. Thus, M. Mireur relates the history of a man and wife who were syphilitic and were never treated, but their children were without syphilitic symptoms.

Acquired syphilis in infancy and childhood may be received through primary lesions—that is, by reception of the virus from a chancre or bubo—or it may be derived from certain of the secondary lesions. Inoculation by primary lesions may occur at the birth of the infant from a syphilitic sore in the vagina or upon the vulva of the mother; inoculation in this manner is, however, rare. Children may also receive the virus from primary lesions on the persons of nurses or companions. Infection in this manner is sometimes accidental and sometimes the result of criminal conduct. A chancre on the breast of the wet-nurse not very infrequently communicates syphilis to the nursling.

The contagiousness of "secondary manifestations," for a long time doubted, is now fully established. Syphilis may be communicated by the secretion or exudation of a mucous patch or a secondary sore. Hence the danger of suckling by infected wet-nurses, though they present no symptoms of recent syphilis. Excoriations or sores upon the nipple or breast of a syphilitic wet-nurse may communicate the disease to the nursling; and, on the other hand, mucous tubercles or fissures upon the lips or tongue of the infected infant may be the means of contaminating a healthy wet-nurse. Many such cases are now contained in the records of medicine. Vaccination by means of the scab is also a mode by which syphilis has been communicated. (For further particulars in reference to this subject the reader is referred to our remarks on vaccination.)

Syphilis is believed to be a microbic disease, but further investigations are required in order to determine positively which microbe is the causal agent. Klebs obtained by cultivation bacilli from rods and spherules which he found in indurated chancres. With these bacilli he produced a local affection by inoculation in the monkey which resembled, in some respects, that of syphilis and in other respects that of tuberculosis. Ziegler and Von Rinecker obtained negative results from similar experiments (Ziegler's *Path. Anatomy*). Lustgarten has described a bacillus which occurs in syphilitic lesions, and which he distinguishes from that of tuberculosis by colorations which the latter receives and this does not. Alvarez and Tavel in 1885, and later Cornil, describe a bacillus found in the desquamation of the genitals which closely resembles Lustgarten's bacillus of syphilis, but which Cornil states can be distinguished from it by certain differences in the coloration (*Cyclop. of Diseases of Children*, vol. i. 168, Phila., 1889).

Dr. W. H. Welch, the distinguished professor of pathology in Johns Hopkins University, has favored me with the following note relating to the micro-organism which causes syphilis:

BALTIMORE, Aug. 14, 1889.

There has hitherto been no satisfactory demonstration of this organism, although there have been many claims to its discovery. The only organism yet demonstrated which has any claims to being considered the cause of this disease is, in my opinion, the bacillus of Lustgarten. . . . . There is much to be said in favor of the bacillus discovered by Lustgarten, and first described by him in November, 1884, and I think this is the only micro-organism hitherto observed in syphilitic lesions which possesses much interest. His work from the first attracted attention, as it was done under the direction of Prof. Weigert, one of the greatest living experts in this line of study. The organism is described by Lustgarten as a bacillus three to seven micro-millimetres long, often slightly wavy in shape, and found usually within the protoplasm of cells in syphilitic products. It was found by Lustgarten in all of the syphilitic products, including gummata, which he examined. Next to Lustgarten's, the most important studies of this bacillus have been made probably by Doutrelepont of Bonn, in co-operation with Schütz; by Matterstock of Würzburg; by Markuse; and by Fordyce. The significance of Lustgarten's discovery for a time seemed to be overthrown by the detection by Matterstock and by Alvarez and Tavel of a bacillus in smegma, which these observers believed to be identical with Lustgarten's syphilitic bacillus; but, although strikingly similar, these two species of organism have now, I believe, been shown to be entirely different species, and the smegma bacillus has nothing to do with the syphilis bacillus.

Lustgarten's bacillus has not been cultivated, notwithstanding repeated attempts to find a medium suitable for its growth. It is certainly often, and probly constantly, present in syphilitic lesions. Still, several observers have ported negative results in searching for it. The reason of this is probably the xtraordinary difficulty in demonstrating this organism. There is nothing in all istological technique which requires such an outlay of time and patience as the emonstration of the syphilis bacillus, so that so skilled an histologist as Weigert says that he simply has not the patience to work at this subject; and his is probably the conclusion of others who have tackled it.

It is clear, however, that the discovery of a peculiar bacillus with remarkable staining properties, enclosed within cells in syphilitic products, is something of great significance—far greater than finding, as did Aufrect, ordinary cocci in juice squeezed out of a flat condyloma, or in mistaking plasma-cells for clumps of cocci, as Birch-Hirschfeld is known to have done. When, in addition to this, the few good observers who, like Lustgarten, have had the patience and skill to make a satisfactory study of the question, claim to find this peculiar bacillus so frequently in the lesions of syphilis, I think it must be admitted that this bacillus has special claims upon our consideration. It must be admitted, however, that a complete demonstration that Lustgarten's bacillus is the specific cause of syphilis has not as yet been furnished.

It may interest you to know that within the last year or two some interest has attached to the observation first made by Kassowitz and Hochsinger, that streptococci are often present in congenital syphilis; but I do not think that there can be any doubt that these streptococci have nothing to do with the specific contagium of syphilis (and, indeed, Doutrelepont has found Lustgarten's bacillus in combination with streptococci in congenital syphilis), but they are evidence of mixed infection. They are probably the ordinary streptococci of suppuration. It is, however, of some interest to have this bacteriological evidence of a clinical fact that many cases of congenital syphilis are examples of mixed infection. It is probable that some lesions of congenital syphilis which have been regarded as specific, particularly those of a suppurative character, are due to the secondary invasion of these streptococci, for which the soil has been prepared by the specific organism of syphilis.

Yours very truly,
W. H. Welch.

It is evident, in consequence of the risk of begetting syphilitic children, that one who has contracted syphilis should not marry or sustain conjugal relations until four years have elapsed from the time of infection and the disease has passed through its first and second stages, and eighteen months of treatment have been employed. We have seen that hereditary syphilis may be inherited from either parent, although the parent do not exhibit at the time any syphilitic symptoms, and that the mother, contracting syphilis during gestation even as late as the seventh month, may transmit it to her infant.

Clinical History.—The effects of the syphilitic poison upon the development of the fœtus and the development and health of the infant are different in different cases. The fœtus, under the influence of the poison, often ceases to grow, shrivels, dies, and is expelled long before term; or it may be born alive, but prematurely, and showing clear evidences of the disease as soon as it comes into the world; or, again, it may be born at term, but dead. So frequently is syphilis a cause of non-viability that, as Trousseau has remarked, this disease should be suspected as the cause whenever a woman repeatedly aborts. Abortion from syphilis commonly occurs at or about the sixth month of gestation. In those cases in which the fœtus dies from syphilis there is often placental syphilitic disease—to wit, an undue growth of cells in the villi, which, compressing the vessels, gives rise to fatty degeneration and prevents the requisite interchange between the maternal and fœtal blood (Harring, Frankell). Frankell designated the change "granulation-cell hypertrophy of the placental villi." Virchow in one case found a gummy tumor in the maternal portion of the placenta.

When a fœtus destroyed by syphilis is expelled, it frequently presents a macerated appearance, the cuticle being detached over large patches of su face, and in other parts raised in blebs, with a thin, puriform, and offensive fluid underneath; the liver is occasionally indurated, and abscesses with spots of inflammation are sometimes observed in the thymus gland; the amniotic fluid is offensive, turbid, and of a greenish or greenish-brown appearance.

If the fœtus in which syphilitic manifestations have begun to occur have reached a viable age and be born alive, it is small and imperfectly developed, often shrivelled and senile in appearance. The skin looks unhealthy, and it may exhibit a distinct rash. Bouchut saw a seven and a half months' infant born alive, with an eruption of a copper color upon the legs and arms and onychia upon the fingers and toes. The bullæ of pemphigus are also not infrequent upon the skin at birth, or they appear within a few days (two or three) after birth. The smallest are about the size of a split pea, but many are considerably larger; the largest consist of two or more which have coalesced. They contain a thin, greenish, purulent matter, and appear most frequently upon the palms of the hands and soles of the feet, but also in severe cases upon the face and over the surface of the body. Recently I was able to diagnosticate syphilis in an infant within a day after birth by its small size and feebleness and the appearance of large blebs of pemphigus upon its hands, feet, fingers, and toes, over which the skin soon broke, leaving troublesome and bleeding sores; coryza commenced about the twelfth day. The parents seemed healthy, but I was enabled to trace the syphilitic taint to the mother. Non-syphilitic pemphigus, the result of cachexia, sometimes appears soon after birth, but its primary and usual seat is around the neck and upon the body. I have known it to appear within the first week of life, and end fatally by the close of the second week. I have not found it difficult to distinguish it from syphilitic pemphigus by the history of the family and its absence from the palmar and plantar surfaces of the hands and feet. Condylomata, mucous patches, and stains of a copper color are the principal syphilitic affections, besides pemphigus, which have been observed at birth on the bodies of contaminated infants. It is stated that M. Cullerier in ten years' attendance at the Hôpital de Lorraine met only two cases of syphilitic manifestations at birth, and Victor de Meric only two cases in forty-six infants, who were affected with congenital syphilis (Bumstead); but in the practice of others a larger proportion have exhibited symptoms at birth. Ordinarily, the period in which congenital syphilis is first revealed by symptoms is between the fifteenth and fortieth days. Rarely the manifestations of the disease are delayed several months. M. Diday ascertained the time of the commencement of symptoms in 158 cases, as follows:

Before the completion of one month after birth, in	86
Before the completion of two months after birth, in	45
Before the completion of three months after birth, in	15
At four months	7
At five months	1
At six months	1
At eight months	1
At one year	1
At two years	1

When the symptoms do not occur until several weeks have elapsed, it is probable that the poison has been partially eradicated from the affected parents by appropriate treatment.

The nutrition of the infant who has inherited the syphilitic taint, but does not exhibit it at birth, is for a time good, but it begins to be impaired when the local manifestations of syphilis appear or soon after. The system gradually wastes; the skin loses its fresh and healthy appearance and becomes sallow, and after a time more or less wrinkled; the features become pinched and contracted and wear a sad expression. M. Diday says: "Next to this look of little old men, so common in new-born children doomed to syphilis, the most characteristic sign is the color of the skin." Trousseau thus described this discoloration of the surface: "Before the health becomes affected the child has already a peculiar appearance; the skin, especially that of the face, loses its transparency; it becomes dull, even when there is neither puffiness nor emaciation; its rosy color disappears, and is replaced by a sooty tint, which resembles that of Asiatics. It is yellow or like coffee mixed with milk, or looks as if it had been exposed to smoke; it has an empyreumatic color, similar to that which exists on the fingers of persons who are in the habit of smoking cigarettes. It appears as if a layer of coloring had been laid on unequally; it sometimes occupies the whole of the skin, but is more marked in certain favorite spots, as the forehead, eyebrows, chin, nose, eyelids—in short, the most prominent parts of the face; the deeper parts, such as the internal angle of the orbit, the hollow of the cheek, and that which separates the lower lip from the chin, almost always remain free from it. Although the face is commonly the part most affected, the rest of the body always participates more or less in this tint. The infant becomes pale and wan."

The infant whose system is profoundly affected by syphilis rarely smiles and its voice is feeble and plaintive; its frequent, whimpering cry is quite characteristic.

Coryza is one of the earliest and most constant of the local affections in infantile syphilis. It is slight at first, attracting little attention on the part of the parents, who are not aware of its significance and usually attribute it to a slight cold; but it gradually increases. It gives rise to a secretion from the Schneiderian membrane, at first thin, but which becomes more consistent and is attended by the formation of scabs. The thickening of the mucous membrane in consequence of the inflammation and the presence of crusts narrows the passage through the nostrils, so as to produce snuffling respiration and sometimes render nursing difficult. In severe cases respiration through the nostrils is almost wholly prevented, so that death may occur from inanition, unless the breast be milked into the infant's mouth or it be fed with a spoon; but ordinarily, even in grave coryza, it continues to nurse, though obliged often to release its hold of the nipple to obtain breath. It is when the coryza interferes with drawing the nipple that it first alarms the parents. The inflammation at the same time may affect the throat and larynx, causing hoarseness of the voice. Ulceration of the Schneiderian membrane and the adjacent cartilage or bone is rare in infancy or childhood, although cases occur which are even attended with more or less flattening of the nose. Diday believes that the discharge which accompanies coryza is in great part due to mucous patches developed on the Schneiderian membrane. The upper lip, over which the discharge flows, becomes red, excoriated, and more or less incrusted. The coryza in most cases coexists with other local syphilitic affections. Occasionally it occurs alone, and is the only evidence of the presence of the specific taint, except such as is afforded by the malnutrition and general appearance of the patient.

Mucous patches occur in most patients. They are developed either upon the mucous surfaces or upon parts of the skin which are thin and exposed to friction, and such as are moistened by secretion or transudation from the vessels underneath. The most common seat of mucous patches is at the termination of mucous canals; but in infancy, on account of the peculiar delicacy of the skin, they may occur upon almost any part of the cutaneous surface.

They are most common, however, around the anus, upon the vulva, scrotum, umbilicus, labial commissures, in the axillæ, and behind the ears.

Mucous patches upon the skin present a rounded border and are slightly elevated. Their color has been compared to that of skin which has been softened by the prolonged application of a poultice. Erosions and cracks sometimes occur in the patches, from which a thin liquid exudes.

Upon mucous surfaces they are less elevated than upon the skin, and are prone to ulcerate. These ulcerations, commencing at the centre, extend, and soon the mucous patch disappears and its site is occupied by an ulcer. The ulcer may be circular, oval, elliptical, crescentic, or irregular. The arches of the fauces are a common seat of mucous patches.

Roseola is an occasional symptom of infantile syphilis. "It is distinguished," says Diday, "by patches of a bright rose color, circumscribed, irregularly rounded, of various sizes (most frequently about as large as one of the nails); appearing by preference on the belly, lower part of the chest, neck, and inner surface of the extremities." The spots do not readily and fully disappear by pressure.

Pemphigus, appearing soon after birth, has already been alluded to. Its most frequent seat, whether occurring at birth or as a subsequent manifestation, is, as we have stated, the palms of the hands, soles of the feet, the fingers, and the toes. This eruption commences by a violet tint of the skin, and in the course of twenty-four to forty-eight hours a watery fluid collects underneath, which soon becomes turbid. The skin peels off, and sometimes an angry sore results, which bleeds readily when rubbed or pressed. In other and more favorable cases new skin takes the place of that which is lost. Pemphigus at birth is a precursor of death, but when it appears for the first time some weeks after birth, it is a less unfavorable prognostic sign. In cases of recovery it disappears, with proper treatment, in two or three weeks.

Acne, *Impetigo*, and *Ecthyma* are occasionally observed in children afflicted with syphilis. The indurated pustules of acne occur most frequently upon the shoulders, back, chest, and buttocks. The pus is sometimes absorbed and in other cases discharged, leaving a small cicatrix, which after a time disappears. Impetigo appears most frequently upon the face, and occasionally upon the chest, neck, axilla, and groin. Unlike simple impetigo, the syphilitic impetiginous eruption is surrounded by a copper-colored areola. Ecthyma occurs upon the legs and buttocks chiefly. It commences as violet-colored spots, which are soon transformed into pustules. Ulcers succeed, which in reduced states of the system sometimes enlarge and endanger the safety of the child. Of the three pustular eruptions, acne, according to Diday, is the least serious, indicating a "less confirmed diathesis." Ecthyma is the most serious, on account of the reduced state of the system with which it is usually associated. Syphilitic papulæ and squamæ are rare in infants, but cases have been observed. Onychia occasionally occurs, though less frequently than in syphilis of the adult.

In an interesting lecture on hereditary syphilis Dr. Miller remarks that polymorphism of its cutaneous eruptions characterizes hereditary syphilis. In 1000 cases of the inherited disease the local affections referable to syphilis, and seated upon or in immediate relation with the cutaneous and mucous surfaces, were as follows:[1]

Papules	74 per cent. of the cases.
Rhagades of the lips and anus	70 " " " "
Rhinitis	58 " " " "
Ulcers of hard palate	52 " " " "
Erythematous eruptions	45 " " " "

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[1] *Pacific Med. Surg. Jour.*, 1888.

Lymphadenitis chronica	20 per cent. of the cases.
Ulcers of tongue (glossitis ulcerosa)	27 " " " "
Bullous eruptions (pemphigus)	25 " " " "
Onychia and paronychia	23 " " " "
Laryngitis	17 " " " "
Pseudo-paralysis of extremities	7 " " " "
Ulcers	4 " " " "
Ulcerative gingivitis	4 " " " "

Visceral Lesions.—The visceral lesions which result from the syphilis of infancy and childhood are suppuration in the thymus gland; gummy tumors in certain organs, most frequently the lungs and liver; increase of the connective tissue of the liver, known as syphilitic cirrhosis; partial perihepatitis, with depressions resembling cicatrices on the surface of the liver; periostitis, with thickening of the bone; and exostosis.

Suppurative inflammation in the thymus gland is not common or has not been frequently observed. When it is present the gland sometimes presents its normal appearance externally, and the abscess is only discovered by incisions. Gummy tumors are white and spheroidal; some are as small or smaller than a pin's head, while others are as large as a pea or even a hazel-nut. I have seen a considerable number of them not as large as a pin's head in the liver of an infant. Gummy tumors, according to Lebert, consist "of loose fibrous tissue made up of pale, elastic fibres, enclosing in their large interspaces a homogeneous granular substance, the elements of which are less adherent to each other than in deposits of true tubercle." Lebert also, with other microscopists, discovered round granular cells in these tumors. According to Robin, gummy tumors "are made up of rounded nuclei belonging to fibroplastic cells, or *cytoblastions;* of a finely granular, semi-transparent, and amorphous substance; and, finally, of isolated fibres of cellular tissue, a small number of elastic fibres, and a few capillary blood-vessels."

Constitutional syphilis is one of the principal causes of waxy degeneration, and the spleen and liver of infants may be enlarged from this cause. Dr. Samuel Gee has expressed the opinion that in half the cases of hereditary syphilis the spleen is enlarged (*London Lancet*, April 13, 1867).

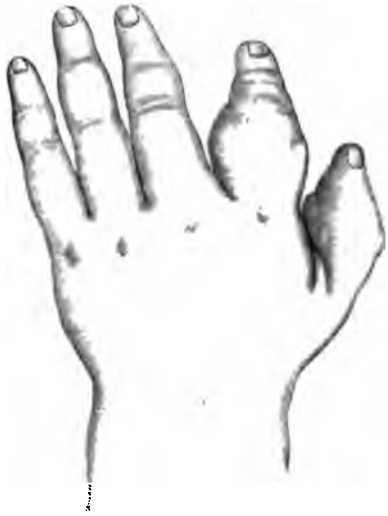
Infiltration of the liver by fibrous substance was first noticed by Gübler. It is not common in the infant. A specimen, showing this lesion, was presented to the London Pathological Society in 1866 by Dr. Samuel Wilks. The following remarks by Dr. Wilks convey a good idea of the appearance and state of the liver in syphilitic cirrhosis: "Having dissected the bodies of several infants who have died of congenital syphilis, I have found fatty livers and an inflammation of the capsule, but in only two have I discovered adventitious products of a fibrous character. The present example, however, corresponds in every particular with the disease described by Gübler. It must be distinguished (at least as far as the naked-eye appearance reaches) from syphilitic disease of adults, of which many specimens have been before the society. In these the organ is cicatrized on the surface and contains distinct nodules of fibrous tissue; while in the disease of children, as in the present specimen, the whole organ is infiltrated by a new material, and it consequently becomes, as described by Gübler, hypertrophied, globular, and hard, resistant to pressure, and even when torn by the fingers its surface receives no indentation from them; it is also elastic, and when cut creaks slightly under the scalpel. This was the form of disease in the present specimen. It came from a syphilitic child a month old, in whom the liver could be felt enlarged during life, and when removed weighed a pound and a half. It was smooth on the surface, and so hard that it resembled rather a fibrous tumor than a liver. It is seen that the liver in the syphilitic child is liable to three distinct pathological processes—namely, gummy tumors, cirrhosis or fibroid degeneration, and waxy degeneration."

Syphilitic perihepatitis and periostitis are more rare in infancy and childhood than in adult life, but they occasionally occur. The late Sir James Y. Simpson considered peritonitis in the fœtus one of the results of syphilis, and a cause of its death.

Osseous Lesions.—Within the last few years important discoveries have been made in regard to the effect of syphilis upon the nutrition of the bones in children. In 1870, Dr. Wegner of Berlin published his observations of the state of the skeleton in twelve syphilitic children who were either stillborn or who died within a few days or weeks after birth. He found clear proof that the syphilitic dyscrasia frequently disturbs the nutrition and produces anatomical changes in the skeleton of the fœtus. The following are the lesions clearly referable to syphilis which he observed: Periostitis of long bones, including the ribs; softening, separation, and sometimes crepitation at the point of union of diaphysis and epiphysis; chalky concretions and infiltrations along the line of ossification; fatty degeneration of marrow; irregular formation and distribution of spongy substance in the epiphysis. These lesions were not all observed in each case, but they occurred with such frequency that there could be no doubt that they were due to the syphilitic taint of system. Confirmatory observations also in twelve cases have since been made by Waldeyer and Köbner.[1]

Again, there is a syphilitic lesion of the bone in children which is not usually present or has not usually been observed at birth, but is developed in the first weeks or months of infancy. The lesion alluded to is a circumscribed enlargement of one or more bones. This has been most frequently observed upon the long bones, including the clavicle and ribs, but in certain children it occurs upon other bones in addition. In some cases it is one of the first manifestations of hereditary syphilis, occurring even sooner than the

FIG. 26.



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[1] See elaborate paper by R. W. Taylor, M. D., *New York Journal of Obstetrics, etc.*, July, 1874.

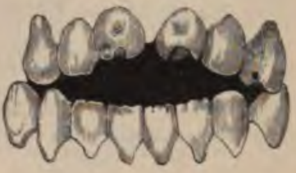
coryza, while in others several months elapse before it appears. In one case reported by Dr. Bulkley[1] of this city it was first seen only a few days after birth, being perhaps congenital; while in another case, in which the enlargement was upon certain phalanges, and which is represented in the accompanying figure, it appeared at the age of twelve months. When it occurs upon a phalangeal bone it is designated *dactylitis syphilitica.*

The enlargement, if upon a long bone, ordinarily begins at or near the point of union of the diaphysis with the epiphysis. It is located upon the extremity of the shaft which it encircles, and it extends over a part or nearly the whole of the epiphysis. It has an elevation of perhaps one-half or three-quarters of an inch in typical cases: its surface is smooth or slightly undulating, and the skin over it, though distended, has its normal appearance and is easily movable, unless ulcerations have occurred.

These enlargements, which result from the specific inflammation occurring in the periosteum and the bone, may resolve under proper treatment; but if neglected and the antihygienic conditions are bad, degenerative changes may occur, ending in ulceration and destruction of the diseased part to a greater or less extent.

Though these bone-enlargements, whenever observed, should excite suspicions of syphilis as the cause, enlargements which present the same general appearance do occur from other causes. Such a case was observed by me in the children's class in the Out-door Department of Bellvue, and Dr. Bulkley details another case in his paper. In the case observed by me the inflammation and enlargement seemed to be strumous. Baumler says: "Dactylitis syphilitica does not always originate in the bone; similar appearances may be produced through gummous formation in the sheaths of the tendons and in the fibrous structure of the finger;" and again, "Its outward appearance may be produced also by tuberculosis, enchondroma, or sarcoma of the bone-marrow" (art. "Syphilis," *Ziemssen's Encycl.*).

FIG. 27.



Mr. J. Hutchinson of London has called attention to the fact that hereditary syphilis, having perhaps been manifested by the usual symptoms during infancy and then becoming latent, may give rise to new symptoms after the fourth year. The most noticeable of these symptoms is a dwarfing of the permanent incisor teeth, which are rounded and peg-like and their enamel notched at the free ends of the teeth. On account of the small size and shape of the teeth there are interspaces between them. This abnormal development is most marked in the central incisors of the upper jaw, and in certain cases it is limited to them, and it never appears in the other incisors unless it does also in them. Another symptom, which only appears in hereditary syphilis, is an interstitial keratitis occurring on both sides and attended by the deposition of fibrin in the substance of the cornea. In a few weeks the inflammation declines, but a slight opacity of the cornea remains. The cerebral nerves may become affected, usually a single pair—if the auditory, deafness resulting; if the optic, dimness of sight. Occasionally there are other manifestations of syphilis in this period, as enlargement of spleen and liver and nodes upon the long bones.

PROGNOSIS.—This depends in great part on the general condition of the patient. If there be much emaciation and the symptoms indicate a deeply-seated cachexia, a considerable proportion of the patients perish. On the other hand, if the general health be not greatly impaired, although the local affections are pretty severe, the prognosis with correct treatment is good. The younger the infant when the symptoms of syphilis appear, the more unfavorable, as a rule, is the prognosis.

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[1] "*Rare Cases* of Congenital Syphilis," *New York Med. Journal,* May, 1874.

TREATMENT.—Parents who beget syphilitic children ought, from a due regard for their offspring, to make use of antisyphilitic remedies, although they present in their persons no evidences of syphilitic taint. A good prescription for the parents is one-sixtieth of a grain of corrosive sublimate in the compound tincture of bark, given twice or three times daily for several months. If the father have had syphilis, both parents should be subjected to this treatment, and it may be continued, at least on the part of the mother, during the first months of her gestation. So small a dose of the mercurial does not, in my opinion, materially increase the liability to miscarry. There is much more danger of miscarrying from allowing the syphilitic taint to remain uncontrolled. Some prefer the use of mercurial ointment in the treatment of pregnant women having syphilis, in the belief that it is less likely to produce abortion. It is used for this purpose in the proportion of one drachm to the ounce. It is equally effectual in the eradication of the syphilitic taint with the small dose of corrosive sublimate recommended above for internal administration; but it is impossible to determine the quantity of mercury which enters the circulation when inunction is employed and salivation is more likely to occur. The following is, however, probably the best prescription for the treatment of parents infected by the syphilitic virus It should be given several months:

℞.	Hydrarg. biniodidi,	gr. j;	
	Liq. potassii arsenit.,	ʒj;	
	Tinc. belladonnæ,	℥ij;	
	Potassii iodidi,	℥ss;	
	Aquæ,	q. s. ad ℥iv.	M.

Dose: One teaspoonful three times daily after the meals.

.Or

℞.	Vini.	℥vj;	
	Pepsini puri in lamellis,	ʒij;	
	Potassii iodidi,	ʒij;	
	Liq. potassii arsenit.,	ʒij;	
	Hydrarg. biniodidi,	gr. j;	
	Qui. et ferri citratis,	ʒij;	
	Syr. simplic.,	ʒij;	
	Ol. anisi,	gtt. iij.	Misce.

Dose: One dessertspoonful three times daily.

The nutrition of the infant that has unfortunately inherited the syphilitic taint requires special attention. Besides exhibiting the characteristic symptoms of the disease, it usually suffers from innutrition, and sometimes passes into a state of decided marasmus. The mother who has given birth to a syphilitic infant should, if possible, wet-nurse it. Even if she never has exhibited any symptoms of the disease in her own person, she cannot contract syphilis from her infant. Colles wrote as follows in 1837: "One fact well deserving our attention is this: that a child born of a mother who is without obvious venereal symptoms, and which, without being exposed to any infection subsequent to its birth, shows this disease when a few weeks old,—this child will infect the most healthy nurse, whether she suckle it or merely handle and dress it; and yet this child is never known to infect its own mother, even though she suckle it while it has venereal ulcers of the lips and tongue." This remarkable law relating to the immunity of mothers has been fully accepted by all subsequent syphilographers. On the other hand, a wet-nurse employed to suckle a syphilitic infant is very liable to contract the disease, through her nipples, from the infected lips of the infant. If a wet-nurse be employed for such an infant, she should be aware of the risk she incurs, and should protect herself by the use of an artificial nipple. At the same time, the infant should be placed fully under antisyphilitic treatment. Artificial feeding, though usually disastrous, is preferable to the propagation of the disease to a healthy wet-nurse.

Syphilis in the infant requires mercurial treatment as in the adult. Mercury may be employed internally or by inunction. Some prefer inunction in the treatment of ordinary cases in the manner recommended by Sir Benjamin Brodie. "I have spread," says he, "mercurial ointment, made in the proportion of a drachm to an ounce, over a flannel roller, and bound it round the child once a day. The child kicks about, and, the cuticle being thin, the mercury is absorbed. It does not either gripe or purge, nor does it make the gums sore, but it cures the disease. I have adopted this practice in a great many cases with the most signal success." The oleate of mercury, 10 per cent., is a better preparation for inunction. Five drops may be rubbed in three times daily. Trousseau, on the other hand, discountenances the use of inunction, since mercurial ointment applied to the skin produces irritation and increases the suffering and restlessness of the child. He prefers the following solution, which is known as Van Swieten's, for internal treatment:

℞.	Hydrarg. bichlorid.,	1 part;
	Aquæ,	950 parts;
	Spts. rectific.,	100 parts. Misce.

Dose: One or at most two grammes (15.434 to 30.868 grains), in milk, daily.

In order to avoid the risk of establishing a diarrhœa, and to leave the stomach free for the employment of other medicines, as cod-liver oil and the iodide of iron, I prefer and commonly prescribe for infants inunction with the mercurial ointment diluted with eight times its quantity of lard, cold cream, or vaseline. It should not be applied as a plaster, but a quantity of the size of a large chestnut should be rubbed three times daily upon the neck or breast of an infant of three or four months. For children over the age of eight or ten months, Van Swieten's or one of the following formulæ may be employed:

℞.	Hydrarg. cum. cretâ,	gr. iij–vj;
	Sach. alb.,	℈j. Misce.

Divid. in chart. No. xii. One powder three times daily.

℞.	Hydrarg. chlor. corros.,	gr. ss–j;
	Syr. sarsæ comp.,	℥ij;
	Aquæ,	℥viij. Misce.

Dose: One teaspoonful three times daily.

℞.	Hyd. chlor. corros.,	gr. ss;
	Potas. iodid.,	ʒj;
	Ferri et ammon. citrat.,	ʒj;
	Syr. simplic.,	℥vj. Misce.

Dose: One teaspoonful three times daily for a child of three to five years.

℞.	Hyd. chlor. corros.,	gr. j;
	Potas. iodid.,	ʒij;
	Syrup. simplic.,	
	Aquæ,	āā. ℥ij. Misce.

Dose: Six drops three times daily for a child of three months.

Prof. A. Jacobi recommends, in the treatment of syphilis of the newly-born, one-twentieth of a grain of calomel, to be given three times daily. An important advantage of its use is the rapidity and certainty of its action.

Mercury, in whatever way employed, should not be discontinued entirely till several weeks after the syphilitic symptoms have disappeared; it is proper to continue it for a time, in diminished quantity and fewer doses, after the health seems fully restored.

When the mercurial is omitted tonics are often required. The preparations of cinchona are useful in certain cases, as are also those of iron. If the patient remain feeble and pallid, presenting evidences of struma, cod-liver oil and syrup of the iodide of iron will be found beneficial, continued for some weeks or months after the mercury is discontinued. Attention should always be given to cleanliness and the hygienic management of the patient. In some instances direct treatment of the local affections is serviceable. To aid in the cure of syphilitic coryza the following ointment should be applied within the nostrils by a nasal sponge three times daily:

℞. Ung. hydrarg. nitratis, ʒij;
Ung. zinci oxidi, ʒij. Misce.

Recently I have been in the habit of employing Squibb's oleate of mercury, 2 per cent., for syphilitic coryza of infants, and the effect has been satisfactory. It may also be employed by cutaneous inunction in the treatment of the general disease.

Condylomata or mucous patches seated upon the cutaneous surface should be dusted with calomel. At my clinique in April, 1871, a child two years and ten months old was presented, with a large condylomatous outgrowth near the anus. The history of the child showed that in all probability the disease had been contracted within a year from syphilitic children in one of the public institutions. Within three weeks this affection disappeared by dusting upon it calomel once daily, with appropriate internal treatment.

The infant should be kept clean by bathing it in tepid water twice daily, and excoriations upon its lips or mucous patches should be bathed before the nursing with some mild disinfectant solution, as boracic acid. The best possible hygienic conditions should be provided for the infant, since cachexia is commonly present. It should be taken outdoor frequently in suitable weather, and its removal from the city to the country, especially in hot weather, may be advisable. The cachexia which remains after the disappearance of the syphilitic manifestations requires the use of tonics, as cod-liver oil and syrup of the iodide of iron.

Syphilitic symptoms may reappear during childhood. The exanthemata rarely appear at this age when the proper treatment has been employed in infancy, but condylomata and gummy tumors may, and they require a return to the mercurial treatment. If the bones are affected the iodide of potassium is the proper remedy. It causes the disappearance of the periosteal pains and swelling, and manifest improvement in the symptoms generally.

SECTION II.

ERUPTIVE FEVERS.

CHAPTER I.

MEASLES.

THE disease known in the vernacular as measles has also the names rubeola and morbilli. It is a common exanthematic affection occurring at any age, but most frequently in childhood. It affects once the majority of mankind. Writers recognize three stages of measles: first, that of invasion, which ends with the appearance of the eruption; secondly, the eruptive stage; and, thirdly, the stage of decline or desquamation.

ETIOLOGY.—Micrococci have been found in the blood of rubeolar patients by Coze and Feltz. Keating also discovered them during an epidemic of malignant measles (*Phila. Med. Times*, Aug. 12, 1882), and Ransome, Braidwood, and Vacher found them in the breath of patients as well as in their tissues (*Brit. Med. Jour.*, Jan. 21, 1882). It seems probable that they are the specific principle; if so, they remain dormant in the system about twelve days, which is the incubative period. Additional observations are required in order to determine positively whether this micrococcus be the causal agent in measles, or whether it may not be some other microbe.

SYMPTOMS.—This disease commences with such symptoms as usually occur in mild but pretty general inflammation of the air-passages—to wit, cough, fever, anorexia, and thirst. The eyes present a suffused, moderately injected, and brilliant appearance, and the buccal and faucial surfaces are injected. The Schneiderian membrane and that lining the larynx, trachea, and bronchial tubes participate in the increased vascularity. The cough at first is dry, and sometimes distinctly croupy. Catarrhal or false croup, indeed, is not infrequent in the initial period of measles. The cough is attended with slight acceleration of respiration and by little or no pain in the respiratory movements. If auscultation be practised at this early stage, we observe the vesicular murmur, somewhat harsh in character, and sometimes sonorous and sibilant râles. A little later râles of a moist character appear.

The patient, if old enough, commonly complains of headache and of dull pain in the epigastric region or the centre of the sternum, due to the bronchitis. With these local symptoms febrile reaction occurs. The temperature rises to about 102° or 103°, as indicated by the thermometer in the axilla. The pulse numbers from 110 to 130 per minute. The febrile movement is greater than in primary tracheo-bronchitis, except when the bronchitis extends to the bronchioles, but it is less than in most cases of scarlet fever.

The fever in the premonitory stage of measles after the first day is not uniform. It is attended by remissions and exacerbations, the former occurring in the first part of the day, the latter in the evening. Sometimes two exacerbations occur in the day. The face is flushed and somewhat swollen, especially during the times of increase in the fever, and the child is drowsy or restless. Vomiting, so common a symptom in the commencement of scarlet fever, occasionally occurs in measles. While in scarlet fever this takes place in the first twenty-four hours, in measles it takes place with about equal frequency at any period previously to the eruption. It was present during the first stage, sometimes almost as late as the eruptive period, in 13, and was absent in 23 cases in which I preserved records in reference to this symptom.

The duration of the first stage varies in different cases. It is usually from two to five days, with an average of about four. Occasionally it is more protracted on account of some disturbance in the economy, either from exposure to cold or other cause, which prevents the necessary afflux of blood toward the surface and retards the eruption. In 18 cases in my practice in which the duration of the cough previously to the appearance of the rash was accurately ascertained, the time varied from one to five days, with an average of three and one-third; in 10 other cases it had continued, the parents stated, about a week; and in 5, from from one to two weeks previously to the eruption.

The eruption commences, when the disease pursues its normal course, upon the forehead and neck, then the face, and gradually extends downward, occupying from twenty-four to thirty-six hours in passing over the trunk and limbs. It appears first as indistinct red points, not more than a line in diameter, which increase in size and become more distinct. Their borders are uneven or irregular or they are finely notched; their general shape is, however, circular, except as two or more unite, when they may assume any form. The crescentic form which writers describe is due to the union of two points of eruption. The largest of these spots, when there is no coalescence, do not exceed a quarter of an inch in diameter, and many are much smaller. Frequently in plethoric children, if there be much fever, there is continuous redness over several inches of surface. The eruption is then confluent. This form is often observed upon the parts of the surface where the capillary circulation is most active when it is discrete elsewhere. In some of these cases diagnosis of measles from scarlet fever is attended with difficulty.

The rubeolous eruption is slightly elevated, the elevation not being appreciable to the sight, but it can be ascertained by passing the finger over the skin, when roughness is felt at the point of eruption. Sometimes the elevation, especially in the commencement of the efflorescence, is not appreciable, even to the touch. The eruption is broad and flat, never acuminate, never changing its form to the vesicular or pustular. It disappears by pressure, and immediately reappears when the pressure is removed. It has been compared in appearance to flea-bites. Small, pointed, papular, vesicular, or pustular eruptions are sometimes seen in connection with those of measles, but they are accidental, occurring in other states of the system, as well as in measles, if there be the same augmented temperature.

In the commencement of the eruptive period the severity of the constitutional and local symptoms increases. The pulse and temperature correspond with the character which they presented during the exacerbations of the first stage. The features are slightly swollen; the eyes still watery and sensitive to light; the conjunctiva, ocular and palpebral, and the mucous membrane of the cavity of the mouth and of the air-passages, continue injected. The tongue is covered with a moist thin fur, and its papillæ are prominent, though less so than in scarlet fever. The cough continues frequent, and is seldom attended with much expectoration in uncomplicated cases; often there is no expectoration whatever. The appetite is lost, but drinks are readily taken on account of the thirst. Diarrhœa sometimes occurs on the first day of the eruption, but it lasts only a few hours, and, if the disease pursue its usual course, abates of itself. With the exception of this the bowels are regular or a little constipated during the eruptive period.

On the second day of the eruption, or sixth of the fever, the symptoms begin to abate. The pulse is less accelerated and the temperature diminishes; the cough is less frequent and is easier, and the flushed and swollen appearance of the face declines. By the close of the third or on the fourth day the rash has disappeared in the order in which it extended over the body. There only remain faint maculæ, which in the course of a day or two fade completely.

With the disappearance of the rash the fever nearly or quite ceases, but a slight and painless cough continues for several days.

Occasionally the eruption presents a livid appearance; this is the rubeola nigra of writers. From cases which I have observed it is my opinion that this should not be considered a distinct species in the vast majority of patients, but that the dark color is due to internal inflammation, usually capillary bronchitis or pneumonia, which prevents full decarbonization of the blood. Rarely, rubeola nigra is due to the vitiated state of the blood or the malignant nature of the disease. The course of the eruption in this form of measles is somewhat different; it continues longer, fades more slowly, and does not disappear so readily on pressure. Traces of it are observed a week or more after its first appearance; it is likely to be fatal. Measles may present this form from the beginning, or, commencing as vulgaris, it may pass into rubeola nigra.

Measles may be irregular in form, but aberrations are less frequent than in scarlet fever. Writers describe measles without catarrh, and, on the other hand, with catarrh, but without the rash. But positive diagnosis in such cases must be difficult. It is probable that simple catarrh and roseola have sometimes been mistaken for the two forms of irregularity mentioned, but when a child in a family of children affected with measles presents all the symptoms of that disease except the catarrh or except the eruption, the diagnosis of irregular measles would, as a rule, be correct.

Occasionally the stage of invasion is very short or even absent. In one case the parents informed me that the catarrhal symptoms began on the day when the eruption appeared. Convulsions sometimes occur at the commencement of measles, as well as during its progress. A single convulsive attack at the commencement is usually not dangerous; when repeated it is more serious; it is also more serious when it occurs in the course of measles. In certain patients the eruption appears in an irregular and partial manner, occurring perhaps at a late period, and indistinctly, upon the trunk alone or upon the trunk and partially upon the legs. In many cases of deferred or partial eruption there is internal congestion or inflammation of some part, which causes withdrawal of blood from the surface, and thus prevents the normal development of the rash.

When the eruption disappears the third stage commences, that of desquamation. It is characterized by a scanty furfuraceous exfoliation of the epidermis. The desquamation is seldom as great as in scarlet fever, and it occurs most where the eruption has been thickest and the epidermis most inflamed. Exfoliation occurs between the fourth and seventh days after the commencement of the eruption, the eighth and the eleventh of the disease. Frequently it does not take place, or is so slight as not to be observed.

With the disappearance of the rash the symptoms rapidly abate. The pulse becomes more natural, the temperature is reduced, the digestive organs return to their normal state, and convalescence is established. The cough continues several days after the other symptoms abate, but it is less and less frequent, and is not painful.

COMPLICATIONS.—The complications of this disease are important. Much of the success of the physician in the management of measles depends upon a correct diagnosis and understanding of them. The most frequent of these complications are bronchitis and broncho-pneumonia. Slight bronchitis is uniformly present in measles, but if it increase so as to cause embarrassment of respiration and become a source of danger, it is properly a complication. This complication, as well as pneumonia, may occur at any period of measles, but it commences most frequently in the first stage. Occurring in the first stage, it may prevent the regular appearance of the rash; if in the second stage, it often causes retrocession of it.

When bronchitis becomes really serious it usually has invaded the minute bronchial tubes. This disease, designated capillary bronchitis or suffocative catarrh, I have elsewhere described. The clinical history of fatal bronchitis as a complication of measles is as follows: The respiration, at first not notably altered, becomes by degrees accelerated and the patient more and more fretful. The pulse, instead of becoming less accelerated, as after the first days of simple measles, is daily more rapid and the respiration more frequent and labored. The dyspnœa gradually increases, the inframammary region is depressed during each inspiration, and the subcrepitant râle is heard on both sides of the chest. There is probably collapse or inflammation of some of the lobules. Finally, the prolabia and fingers become livid, and death occurs from apnœa. Capillary bronchitis, occurring as a complication and continuing as a sequel of measles, usually becomes a broncho-pneumonia. A large proportion of those affected under the age of three years die. The anatomical characters of fatal bronchitis occurring in connection with measles we have had frequent opportunities to inspect in the Foundling Asylum and Infant Asylum. In some cases there have been evidences of continuous inflammation from the epiglottis downward, ending in lobular or broncho-pneumonia. Broncho-pneumonia as a complication does not differ materially from the idiopathic inflammation, except that it is more protracted and fatal.

The next most frequent serious complication of measles is entero-colitis. This may commence at any period during the course of the disease. If the colon be more especially the seat of inflammation, the evacuations contain mucus and blood, unless in young children, in whom the stools, even in severe colitis, commonly have a green color. The anatomical character of this complication varies in different cases, like the idiopathic form of inflammation. Sometimes there is simple arborescence of the intestinal mucous membrane, with tumefaction of its follicles; in other cases, in addition to increased vascularity, the mucous coat is softened and thickened; and in others still, especially if the inflammatory action has been protracted, ulceration occurs, for the most part in the site of the solitary glands. Exceptionally, in fatal cases of measles attended with diarrhœa, no vascularity is observed after death, although the intestines may be thickened and softened. In such cases the diarrhœa was probably inflammatory, the injection of the vessels having disappeared after death.

Severe and obstinate diarrhœal affections occurring with measles usually commence as the primary disease is about declining. They then become sequelæ, ending fatally in many instances, especially in the summer months, several days or perhaps weeks after the disappearance of the eruption. Diarrhœal attacks occurring in or previously to the eruptive stage are, as a rule, mild and easily relieved.

In some grave cases measles have a tendency from the first to affect the internal organs more than the surface. Bronchitis, pneumonia, and entero-colitis may coexist with indistinctness of the eruption on the skin. Such complications render a fatal result highly probable.

Eclampsia is also an occasional very dangerous complication. It sometimes occurs very suddenly and unexpectedly. A child of five years, in my practice, apparently progressing favorably with measles, was allowed to sit at dinner with the family; suddenly and without premonition eclampsia occurred, the rash receded, and notwithstanding vigorous treatment death resulted in a few hours. Rapidly-developed cerebral congestion seemed to be present. To prevent such a complication the patient should remain quiet in bed during the eruptive stage.

Another very fatal complication and sequel is pseudo-membranous laryngitis, commencing when rubeola is beginning to decline; but it is less frequent than pneumonia or entero-colitis. In catarrhal or false croup—which, as has been previously stated, is not infrequent at the commencement of measles—the cough has a loud, ringing character. In membranous laryngitis, on the other hand, it is hoarse or harsh and less distinct, on account of the presence of the pseudo-membrane in the larynx. This form of laryngitis, always a grave disease, is more serious when it occurs as a complication of measles than when it is idiopathic, not only because the blood is vitiated and the system reduced by the primary affection, but because the inflammation of the mucous surface is in general more extensive, as is also the pseudo-membrane. This membrane in the croup of measles often extends so far down the air-passages that neither intubation nor tracheotomy can produce any decided amelioration of symptoms. This complication, though always grave, is not, however, necessarily fatal. I have known cases recover by inhalation of solvent sprays when for days there had been dyspnœa and other evidences of a pretty firm pseudo-membrane. True croup causes continuation of the fever, which had perhaps begun to abate.

Diphtheria, when epidemic, also frequently complicates measles. Much of the mortality from measles in this city since the year 1858 was due to this cause. In cases observed by myself diphtheria usually began while the fauces were still inflamed, and sometimes before the eruption had begun to fade. The pseudo-membranous laryngitis or true croup mentioned above is, in most instances, in localities where diphtheria prevails, a local manifestation of this disease.

These are the most common complications of measles. There are others of less frequent occurrence, among which may be mentioned stomatitis, pharyngitis, and otitis sufficiently severe to be considered complications. Rarely, also, purpura, attended by hemorrhages from the different mucous surfaces, occurs in connection with measles. This complication is, however, more frequent in certain other constitutional diseases, as scarlet fever, and especially variola.

It is seen that the inflammations which occur in the course of measles are chiefly of the mucous surfaces. In scarlet fever, on the other hand, the inflammations are more frequently of serous surfaces.

There are other affections originating in measles which are rather sequelæ than complications. Gangrene of the mouth is one which, as stated in another part of this book, occurs more frequently after measles than any other disease. After a severe epidemic of measles in the New York Foundling Asylum in 1874 three cases of gangrenous vulvitis occurred in those who had been affected. Ophthalmia commencing in measles often persists for weeks or months. It may give rise to granulation of the lids, and cases have been reported of violent inflammation of a purulent character producing ulceration of the cornea and destroying vision. The ophthalmia is sometimes very intractable. Inflammation of the Schneiderian membrane, commonly present during measles, often continues as a sequel, extending back as far as the Eustachian tube, where it may cause swelling, with impairment of hearing, and forward to the lip, where it may produce chronic eczema. Prof. Moos has described the lesions which occur in the labyrinth in measles when the ear is affected. Cells and coagulated lymph fill the semicircular canals and the cochlea, and collect in the lymphatics. The blood-vessels in the Haversian canals and in the spiral ligament are nearly destroyed. The nerves become gelatinous and atrophy; the muscular fibres undergo waxy degeneration. Notwithstanding such lesions, permanent deafness is rare and reparation seems possible (*Congress at Wiesbaden*, Sept. 22, 1887).

ANATOMICAL CHARACTERS.—I have made or witnessed, mainly in institutions, a considerable number of post-mortem examinations of those who have died in or after an attack of measles. In all there were lesions due to complications. Indeed, death directly from measles is so rare that few have had an opportunity of studying the anatomical charcters apart from the complications. In those who have died without any obvious coexisting disease—and these cases chiefly occur in the malignant form—there has been congestion of the internal organs, especially marked in the lungs, and sometimes the tissues appeared softened. The blood also in the malignant form has a darker hue than natural, and ecchymotic patches have been observed upon the mucous surfaces and elsewhere, corresponding in character with the petechiæ under the skin which sometimes occur in this form of measles. In cases resulting fatally from bronchitis or pneumonia the bronchial glands are commonly tumefied in the same manner as the mesenteric glands are enlarged in enteritis and the glands of the mesocolon in dysentery.

NATURE.—Rubeola, like the other exanthematic fevers, is due to a materies morbi, probably micrococci, as has been stated above. It is highly contagious through the air. It has been inoculated by the serum from vesicles which sometimes occur in connection with the rubeolous eruption, and also by the blood from a patient. Inoculation does not appear to moderate the disease, and as measles, when contracted in the ordinary way, is not in itself dangerous, but dangerous only from complications, inoculation is not performed except as a matter of scientific interest. The usual mode of propagation is through the air. Measles is communicated by the breath and probably by exhalations from the surface. Under whatever circumstances it occurs, the specific principle has been communicated from some infected person. We frequently meet cases, as one in a sparsely-settled district that has come to my knowledge, in which exposure cannot be traced. Yet the immunity of certain islands for centuries till infected through commerce renders the doctrine of an origin *de novo* improbable.

Twelve to fourteen days elapse from the time of infection to the commencement of the eruption. In cases observed in the children's department of Charity Hospital the incubative period was ascertained to be about twelve days. In those who have been inoculated the incubative period is said to have been about one week. Rubeola prevails epidemically, like the whole class of infectious diseases, and in different epidemics the type may vary as well as the character of the complications.

Diagnosis.—The diagnosis of measles previously to the eruption is often difficult. The catarrhal symptoms then predominate, and these are such as may occur independently of any constitutional or blood disease. The first stage, therefore, is not infrequently mistaken for coryza or mild bronchitis. The points of differential diagnosis are the suffused appearance of the eyes, the greater degree of fever on the first day than would be likely to arise from so moderate an amount of local disease, and morning remission and evening exacerbation of the fever. Measles in the first stage has been mistaken for remittent fever. The catarrhal symptoms should prevent such an error.

Sometimes roseola closely resembles measles in appearance, but the rash of roseola appears within a few hours after the commencement of febrile symptoms, and almost simultaneously over the whole body, and without those local symptoms referable to the mucous surfaces which characterize measles.

Variola on the first day of the eruption has sometimes been diagnosticated measles. I recollect once being called to an infant with fatal confluent smallpox who was said to have measles. A physician a few days previously, observing the red points in the commencement of the eruption, had made this absurd diagnosis, and, predicting a favorable result, had not thought it necessary to repeat his visit. In case of doubt it is the part of prudence to defer making a positive diagnosis. A few hours suffice to show the distinctive characters of rubeolous and variolous eruptions. But the anxiety of friends often necessitates the expression of opinion. The absence or lightness of catarrhal symptoms, the earlier appearance of the eruption, and its papular feel under the finger in smallpox, enable us to discriminate between the two diseases in the commencement of the eruptive stage. Moreover, the symptoms in the initial periods are different, as will be seen in our description of smallpox.

Prognosis.—This is favorable, provided that no serious complication arises. With internal inflammatory complication, on the other hand, the disease becomes much more grave. A large proportion thus affected die. The prognosis is less favorable in feeble children with scanty eruption or an eruption appearing at a late period and irregularly. Dyspnœa, persistent and great acceleration of pulse, and coma indicate an unfavorable ending. Convulsions occur much more rarely in the course of measles than in scarlet fever, and when they occur after the initial period they usually end in coma and death. The mortality from measles varies greatly according to the severity of the type, but more according to the season, the locality, the surroundings, and the care which the patients receive, which determine the liability to complications. Thus in the cities the mortality is large from measles in the hot months among infants, who at this time are very liable to gastro-intestinal catarrh. It also seems to be larger in the asylums than in family practice. In epidemics in Boston and Pont de l'Arche the mortality was 5 per cent. of the cases, in Neufchatel, Switzerland, 2 per cent., and among the Sioux Indians, at Crow Creek Agency, Dakota, 6.66 per cent. (*Therapeutic Gaz.*, July 16, 1888).

Treatment.—Uncomplicated rubeola requires little medicinal treatment except to palliate symptoms. The child should be kept in an airy apartment at a uniform temperature of about 70°. A temperature so elevated as to be uncomfortable to the nurse is injurious to the patient. But while the popular idea is erroneous that he should be kept in a heated atmosphere, it is correct that currents of air and sudden reduction of temperature are dangerous. A violent and fatal attack of croup occurred in my practice in a girl of fifteen in consequence of exposure at an open window at the close of the eruptive stage. The diet should be mild, and for the most part liquid. The patient, indeed, refuses solid food, but on account of the thirst takes liquids more readily. Farinaceous substances, with milk, afford sufficient nutriment in ordinary cases. If the previous health have been poor and the vital powers reduced, or if there be a complication, more sustaining diet is required. Stimulation by wine or brandy is needed in these cases. During the two or three weeks succeeding an attack of measles care should be taken to avoid exposure to cold or changes of temperature, since during this period there is great liability to inflammations of the mucous surfaces.

The cough ordinarily requires treatment, inasmuch as the suffering of the child and loss of sleep are largely due to this symptom. Demulcent drinks, as flaxseed tea, infusion of slippery-elm bark, or solution of gum Arabic, are useful, to which, to render them more palatable, lemon-juice may be added. A small Dover's powder or the mistura glycyrrhizæ composita of the Pharmacopœia, given occasionally, relieves the severity and diminishes the frequency of the cough.

As the chief danger in measles is from inflammation of the respiratory organs, local treatment directed to the chest is important. The chest should be covered with cotton wadding or in cold weather even oil-silk, unless in the mildest cases. This increases the amount of eruption upon the surface underneath, and, I believe, tends greatly to prevent complication by capillary bronchitis and pneumonia. If the eruption be tardy in its appearance or indistinct, it is well to produce moderate counter-irritation by some gentle irritant underneath, as camphorated oil, to which in older children a little turpentine may be added.

Affections which complicate measles should receive, for the most part, such treatment as is appropriate for them when idiopathic. Secondary diseases, however, require sustaining measures more than primary. In bronchial and pulmonary inflammations—which if they occur early in measles prevent the regular appearance of the eruption, or if in the eruptive stage cause its disappearance—prompt counter-irritation over the chest by sinapisms or otherwise is required. Trousseau states that he has derived benefit in these cases from what he designates urtication. This is produced by stroking the chest two or three times daily with the nettle (*Urtica dioica* or *Urtica urens*). This causes a prompt and abundant eruption, and with a less amount of suffering than one would suppose. The fever abates, and the respiration becomes more natural in proportion to the amount of nettlerash. On the second day the effect is less than on the first, and after three or four days, says Trousseau, no further irritation results from the nettle. When counter-irritation is produced, by whatever method, the chest should be covered with a warm and soft poultice, as the ground flaxseed; derivatives to the extremities are useful in such cases. In capillary bronchitis and pneumonia stimulating expectorants are required, as carbonate of ammonium. I frequently write the following prescription. It is useful both as an expectorant and cardiac stimulant. Given in milk or after food is taken, it does not produce gastritis, as it often does in a more concentrated form:

℞. Ammon. carbonat., gr. xvj–ʒss;
Aquæ puræ, ℥ij.

Give one teaspoonful in three or four of milk every hour or two.

Chloride of ammonium is also a good remedy in these cases, employed in double the dose of the carbonate.

Quinia to reduce the fever and digitalis or strophanthus or camphor as a heart tonic are also very useful in these inflammations, given alone or alternately with the above.

The cases of gangrenous vulvitis alluded to above were treated with a flaxseed poultice, and iodoform dusted over the surface each day or second day, with a satisfactory result. As regards the treatment of other complications the appropriate measures are detailed elsewhere.

CHAPTER II.

SCARLET FEVER.

It is supposed by some who have studied the history of scarlet fever that it is of ancient origin, but the descriptions of diseases left us by the old writers, and by those in the Christian era until after the Middle Ages, are so obscure or differ so widely in the statements made from the symptoms of scarlet fever as it occurs in modern times that the impartial critic fails to find any clear evidence of its occurrence prior to the last four or five centuries.

The first clear and undoubted portrayal of this disease is found in the medical literature of the sixteenth century. Sydenham and his contemporaries in the seventeenth century witnessed epidemics of it and studied its nature more thoroughly, and consequently acquired a more accurate knowledge of it than that possessed by their predecessors. It was in this century that measles and scarlet fever were differentiated. During the last two hundred years scarlatina has been the subject of monographs too numerous to mention. It has long been regarded as one of the most important maladies of childhood, on account of its frequency and the great mortality that attends it, so that numerous cases and many epidemics are every year related in the medical journals. By this vast accumulation of observations and the patient and thorough use of the microscope our knowledge of scarlet fever has become full and accurate.

As with most of the infectious maladies, scarlet fever was introduced into the Western Hemisphere by European navigators. It was brought to North America about the year 1735. Tardily it spread to South America, where it appeared in 1829, and more recently it has been established in Australia. It entered Iceland in 1827 and Greenland in 1847.

Etiology.—As yet, observers do not agree in regard to the parasite which is supposed to sustain a causal relation to scarlet fever. Klebs states that it is highly probable that both measles and scarlet fever are produced by micrococci, and he has sketched the design and described the development of a microbe which he designates the Monas scarlatinosum.

The *London Medical Times and Gazette* for Jan. 28, 1882, contains an account of the supposed discovery of the scarlatinous microbe by Eklund of Stockholm, an authority in the microscopic examination of parasites. He says that scarlet fever is rarely absent from the Swedish capital and from the barracks and dwellings on the isle of Skeppsholm. In the urine of scarlatinous patients he has constantly found a prodigious number of discoid corpuscles, oval or round, their diameter being less than $\frac{1}{1000}$ millimetre, and from $\frac{1}{30}$ to $\frac{1}{10}$ that of a red blood-cell. They are colorless or yellowish-white, surrounded by a distinct cell-wall, each containing a well-defined nucleus of a deeper hue. Sometimes one, sometimes more, of them are seen in the field of the microscope. They exhibit rotatory or oscillatory movements, especially observed when a drop of water is added to the fluid. They multiply, as Eklund has frequently seen, by fission—first in the microbes, next in the nucleus, and lastly in the cell-wall. He cannot say whether they develop into a mycelium. At any rate, the development of fine filaments seems to be exceptional. He has never seen them adhere in moniliform chains nor massed as zoöglœa. He considers them to be veritable schizomycetes, and proposes the name Plox scindens.

Eklund asserts that he has found these organisms in vast numbers in the soil- and ground-water of the isle of Skeppsholm, in the mud of the trenches dug for the water-mains, and in the greenish mould upon the walls of the old barracks, where scarlet fever was most rife. He states that scarlet fever has occurred in children after drinking milk mixed with the ground-water of the island, and he observed a case which followed immersion in one of the trenches of the island and the drying of the clothes in a small room. In another instance scarlet fever broke out in a block immediately after exposure of the ground-water by excavations. It is evident that the discovery of this microbe under such circumstances does not prove that it is the cause of the disease. This can only be determined by inoculation or by experiments which furnish the conditions of scientific exactness. In 1886, Dr. Edington of Edinburgh isolated a diplococcus and a bacillus from the blood and epidermis of scarlatinous patients. He states that inoculation of the bacillus in rabbits caused erythema, followed by desquamation. But these observations, as detailed in the *Lancet*, show possible sources of error, and have therefore attracted but little attention.

Dr. E. O. Shakespeare describes the bacillus scarlatinæ of Edington as "rods measuring 0.4 m. in thickness and 1.2 m. to 1.4 m. in length, most usually forming excessively long-pointed and curved leptothrix filaments, motile;" and he remarks, "it is pretty well proven that this bacillus scarlatinæ is the specific cause of scarlet fever."[1]

Whatever may be the micro-organism which causes scarlet fever, its mode of action and effects have been ascertained by clinical observations. Without doubt, it commonly enters the system by the breath, but it probably may enter in the ingesta and it infects the blood. That it resides in the blood has been ascertained by inoculation with this liquid, by which scarlet fever has been reproduced in its typical form. From the blood it enters the tissues and secretions. Hence handkerchiefs or linen containing the saliva or mucus of a patient, the epidermic scales shed abundantly in the desquamative period, and probably also the urinary and fecal evacuations, contain the poison, so as to be highly infectious. Even the discharge of a scarlatinous otorrhœa is thought by some to be contagious for a considerable time.

Scarlatina is communicable not only by direct exposure to a patient, but also by exposure to objects which happen to be in his room during his illness, and to which the poison becomes attached, such as clothing, books, and toys; small packages, as we have stated above, sometimes convey and disseminate the contagious principle.

In England observations have been made which show that scarlatina has been communicated by infected milk. The disease occurred in the family of a milkman, and the milk, before it was distributed, remained for a time in a kitchen which had been occupied by the patients. This milk was taken by twelve families, and in six of these scarlatina occurred almost simultaneously at a time when few cases were occurring in the locality. There had been no direct exposure to the carrier of the milk nor to members of the affected family (Taylor). In another instance a woman and her son had scarlet fever while they were serving milk to several families, and the disease appeared in all these families except one, which consisted of old people (Bell). It is known that milk absorbs volatile substances so as to be flavored by them, as is shown in the experiment of placing it in an open vessel in a box with a pineapple; and it may in a similar manner become infected by the specific principle of scarlet fever, or it may be infected by detached particles of epidermis; which is not improbable when one convalescing from scarlet fever is allowed to milk the cows or prepare the milk for distribution. In 1885 an epidemic of scarlet fever in London was traced to the milk-supply coming from a certain dairy in Hendon. The health officer of Hendon discovered a contagious disease in the cows of this dairy communicable to healthy cows by inoculation from the teats, and also communicable to man. The symptoms in the cow were fever, cough, sore throat, discharge from nostrils and eyes. Communicated to man, the disease produced malaise, and in four or five days a vesicle. Crookshank believes that the Hendon disease was the Jennerian cowpox, and the symptoms certainly bore a closer resemblance to cowpox than to scarlet fever. Probably, therefore, the scarlet fever in London originated from some other source (*London Lancet*).

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[1] *Annual of Med. Sci.*, vol. v., 1888.

The scarlatinous virus surpasses that of any other eruptive fever except smallpox in its tenacious attachment to objects and its portability to distant localities. Hence in the literature of the disease are the records of many cases in which the poison was conveyed long distances, retaining its virulence to the full extent and causing an outbreak of the malady in the localities to which it was carried. In New York, so frequently has scarlet fevor as well as measles and diphtheria been contracted from the persons or clothing of well children who come from infected houses, that the Health Board now exclude from the public schools all children who come from such houses, even though they live on separate floors from those occupied by the sick. In one instance that came under my notice a washerwoman whose child had scarlet fever communicated the disease to an infant in the household where she was employed, by placing her shawl over the cradle in which it was lying. A physician of my acquaintance went from a scarlet-fever patient to a family several streets distant, and took one of the children upon his lap. After the usual incubative period this child sickened with a fatal form of the malady, and the remaining children of the household were in time affected. In New York scarlet fever has seemed to me to be not infrequently communicated through school-books, which, profusely illustrated by pictures and rendered attractive to the young, are often allowed to lie upon the bed of a scarlatinous patient, and be handled by him during convalescence or even during the course of the fever if it be mild. The young librarian of the circulating library of a Sunday-school, whose pupils came largely from the tenement-houses, was occupied a considerable part of a day in covering and arranging the books. After about the usual incubative period of scarlet fever he sickened with the disease. His two sisters were immediately removed to a rural township three hundred miles away, and to an isolated house where scarlatina had never occurred. About one month after his recovery, and after his room had been disinfected by burning sulphur and his bedclothes and linen had been thoroughly washed, and all articles suspected to hold the poison had been either disinfected or destroyed, the brother visited his sisters in the country. Three weeks subsequently to his arrival one of these sisters sickened with scarlet fever, and a week later the other also. It seems that the exposure must have occurred several days after his arrival in the country from some books or other infected article in his possession. About two months elapsed after the last case; the family had returned to the city, the infected room in the country-house had been thoroughly fumigated by burning sulphur from morning till evening, when a little girl from an inland city remained a few days in this house, and probably often entered the room where the young ladies had been sick. In a few days she also sickened with a fatal form of scarlatina. Such histories and experiences are not infrequent. They are common during epidemics of scarlet fever. They indicate an extraordinary attachment of the scarlatinous poison to objects, and show that it is not gaseous nor readily volatilized.

A striking example of this fixity of the poison occurred in the practice of the late Kearney Rogers, formerly a prominent and much-esteemed surgeon of New York City. Six children in a family had scarlet fever. Three and a half months subsequently another child, living at a distance, was allowed to return home and occupy the apartment in which the sickness had occurred. One week subsequently to the date of the return this child sickened with the same malady. Elliotson states that a patient with scarlet fever was admitted into one of the wards of St. Thomas's Hospital, and for two years subsequently young persons who were admitted into the ward were apt to take the disease. Richardson of London relates the following experiences of a family whom he attended in the rural district: "At a short distance from one of our villages there was situated on a slight eminence a small clump of laborers' cottages, with the thatch peering down on the beds of the sleepers. A man and his wife lived in one of these cottages with four lovely children. The poison of scarlet fever entered the poor man's door, and struck down one of the flock." The remaining children were now removed some miles away, and after several weeks one of them was allowed to return. Within twenty-four hours he also took the disease, and quickly died. The walls of the cottage were now thoroughly cleaned and whitewashed, the floors scoured, and all the wearing apparel either destroyed or washed. Four months elapsed after the last sickness when one of the remaining children returned. "He reached his father's cottage early in the morning; he seemed dull the next day, and at midnight I was sent for, to find him also the subject of scarlet fever. The disease again assumed the malignant type, and this child died." Richardson believes that the contagion was attached to the thatch, which could not be thoroughly disinfected. The fact of this remarkable long-continued attachment of the poison to objects, indicating by this fixity that it is a solid, is consonant with the theory that it is an organism.

INCUBATIVE PERIOD.—The duration of the incubative period varies in different cases. It is sometimes less than twenty-four hours, as in the above case reported by Richardson; in the following well-known case, observed by Trousseau, it was one day: A girl arrived in Paris from Pau, where there was no scarlet fever, and occupied the same apartment with her sister, who was sick with this disease. Twenty-four hours after her arrival she was also attacked with the same malady.

Russeberger attended a child who was exposed at noon to scarlet fever, and took the disease on the following night. B. W. Richardson (*Clinical Essays*, 1861, vol. i. p. 94) gives his own experience. He had applied his ear to the chest of a patient suffering from scarlet fever, and was conscious of a peculiar odor emitted from the patient. He was immediately nauseated and chilly, and from that moment he dated the beginning of an attack of scarlet fever. In the *Transactions* of the Clinical Society of London, vol. ix., 1878, the late Charles Murchison gives the statistics of 75 cases showing the incubative period, as follows:

In 4 cases it was not more than . . . . 24 hours.
" 2 " " " " . . . . 30 "
" 3 " " " " . . . . 36 "

In 4 cases it was not more than	40 hours.
" 1 " " " "	41 "
" 4 " " " "	58 "
" 1 " " " "	54 "
" 1 " " " "	2½ days.
" 31 cases it was within (time not accurately ascertained)	4 "
" 2 cases the incubation did not exceed	4½ "
" 17 " " " " "	5 "
" 2 " " " " "	6 "

In 3 cases Murchison believes that the incubation was precisely fixed at thirty-six hours, three days, and four and a half days.

Watson says that a man reached Devonshire at mid-day to see his daughter, who had scarlet fever. Two days later he was also attacked. Rehn saw a child who was attacked two days after its grandmother returned from a case of scarlet fever; and Zengerle, a girl of ten years, residing at Wangen, where there was no scarlet fever, who took the disease two days after her mother had returned from visiting a family affected with it. Loochner states that a boy aged four and a half years was attacked one and a half days after admission into the infected wards of a hospital. Armistead, in his annual report on the health of the Newmarket rural district, states that three children, coming from a different part of the district, visited Wesley, and stayed next door to a child who had had scarlet fever six weeks previously, and who was allowed to play with these children on the evening of August 13th and morning of the 14th. The family then returned home, and on the 18th, four days after the exposure, all three children sickened with scarlet fever (*British Medical Journal*, September 30, 1882).

Ordinarily, therefore, the incubative period, though varying in different cases, is within six days. Many cases, however, occur in which it seems to be longer. Thus, in my practice scarlet fever appeared in a family on April 26, 1882. The patient was immediately removed to the third floor and the other children to the basement. All communication between the infected room and the basement was forbidden, but on May 8th, twelve days after the separation, one of these children sickened with the disease. Many observers, among whom may be mentioned Niemeyer and Copland, believe that the incubative period may be longer than one week, but on account of the subtlety of the poison and the many modes of transmission, it is possible that in the instances of an apparently long incubative period there were other and unsuspected exposures. When scarlet fever has been communicated by inoculation, as in the experiments of Rostan and others, the incubative period has been about seven days, but Gerhardt states that a man was attacked four days after an abscess was opened by a knife used upon a scarlatinous patient. This variation in the incubative period, which also occurs in some other infectious diseases, as diphtheria, is probably due mostly to individual differences, some being more susceptible than others; but it may be due partly to those obscure meteorological conditions which we designate the epidemic influence. Probably, as a rule, when the disease is quickly developed after exposure the attack is more severe than when several days elapse.

CONTAGIOUSNESS.—The area of the contagiousness of scarlet fever is small: it apparently embraces only a few feet. Therefore, close proximity is the necessary condition of its propagation. Hence many who are exposed, particularly of those who are remotely exposed, do not contract the disease. There is also an idiosyncrasy in some children, so that they resist infection even when repeatedly and closely exposed. In the *New York Medical Record* for March 23, 1878, C. E. Billington states that of 90 children in 26 families who were exposed to scarlet fever, 43 contracted the disease and 47 escaped; whereas, as is well known, comparatively few unprotected children escape pertussis, variola, varicella, or measles if exposed to either of these diseases. By strict isolation, therefore, the spread of scarlet fever is more easily prevented than that of most other acute infectious maladies. In the New York Foundling Asylum for a number of years children with scarlet fever were isolated in a small room attached to one of the wards. The door between the two rooms was closed, and not opened during the continuance of the sickness. Entrance into the small room was through another door, and a nurse was assigned to the scarlet-fever cases, with strict directions that she should not mingle with the other children. These simple precautions were found sufficient in the various epidemics of scarlet fever which occurred in the city to prevent the spread of the malady through this institution; whereas, similar measures were much less effectual in arresting the spread of measles and pertussis. Consequently, an outbreak of scarlet fever in this institution was usually limited to a few cases, while the extension of measles and pertussis was arrested with difficulty till a more efficient quarantine was established.

VARIATIONS IN TYPE.—The type of scarlet fever varies greatly in different epidemics, and frequently also in cases which occur in the same epidemic, even in the same family. One child may have scarlatina so mildly that little treatment is required and convalescence soon begins, while another has the malignant form, and soon succumbs, notwithstanding the prompt employment of the most efficient and appropriate measures. Ordinarily, however, if the first case in a family be very severe, subsequent cases will present a similar type; but there are notable exceptions. This variation in type in different years and different epidemics is probably not equalled in any other infectious malady. Consecutive epidemics may present this variation, or the same type may continue for a series of years, and then, from some unknown cause, change to one milder or more severe. In England, during Sydenham's life, scarlet fever was so mild that he regarded it as a trivial affection, requiring little attention, like rötheln of the present time; but after the death of Sydenham, Morton and his contemporaries in London found, to their sorrow, that the type of scarlet fever was very different from that described by Sydenham's pen. The late Dr. Graves of Dublin and his contemporaries treated a mild type of scarlet fever with a very small percentage of deaths —much less than that during the preceding generation—and they attributed their success to their greater knowledge and more appropriate use of remedies than their ancestors possessed and employed. By and by the type changed, the mortality of former years was restored, and they discovered that their previous success in saving life had been due not to their skill, but to the mild form of the malady. A distinguished physician of New York treated more than fifty cases of scarlet fever in one of the institutions without a single death. A few months afterward the type of the malady changed, and his own son perished from it.

SURGICAL SCARLATINA.

After surgical operations, and sometimes in surgical cases not requiring operative measures, a scarlatinous efflorescence occasionally appears upon the whole or nearly the whole body, and remains for several days. The following were cases of the kind alluded to. They occurred in Guy's Hospital, and were published by H. G. Howse in *Guy's Hospital Reports* for 1879: On March 15, 1878, Jacobson performed osteotomy upon a child suffering from extreme rachitis. The operation was followed by a moderate febrile movement (100° to 101°), and after three days by the appearance of an efflorescence, with sore throat and the strawberry tongue. The osteotomy had been performed under carbolic-acid spray and with all the details of antiseptic surgery. The rash soon faded, the temperature fell, and the child, temporarily separated from the other patients from the suspicion that the disease was scarlet fever, was brought back to the ward. The subsequent history confirmed the diagnosis of scarlet fever, for the skin desquamated, and on April 1st abundant albumen was found in the urine. The case terminated favorably. Three months previously the same operation had been performed on the other leg, with no unfavorable symptoms. On April 5th, three weeks after the osteotomy, a lipoma was removed from another patient aged twenty-one years. The following day the temperature rose to 101°, and remained at that till April 8th, when it suddenly increased to 103°, and a rose-rash occurred over the body, with sore throat. On April 9th, Howse excised the elbow-joint of a girl of sixteen years having pulpy disease. On the 10th her temperature began to increase, and on the 11th reached 105.8°. Toward evening a roseoloid eruption appeared over her body, and she was isolated. On April 12th, Dr. H. excised a fibroid bursa patellæ from a woman of twenty-nine years. On the following day her temperature was 99°, but on the 14th it rose to 100°, and on the evening of the 15th she had rigors and headache. On the morning of the 16th the temperature was 102.5°, and a roseoloid eruption occurred over the face and chest. The surgeons now perceived that an epidemic of the so-called surgical scarlatina was occurring, so as to justify the postponement of other operations.

In the same volume of *Guy's Hospital Reports*, James F. Goodhart gives the histories of nearly thirty cases of this disease occurring during a series of years in the same hospital. The patients were chiefly children, having the most diverse surgical ailments, among which may be mentioned hip disease and abscess, genu valgum without operation, necrosis of femur, hydrocele with explorative operation, a scald, a sinus over the great trochanter, spinal disease with abscess, tenotomy for club-foot, and vesical calculus with operation. The most common disease was caries or necrosis with abscess. In cases operated on the intervals between the operations and the occurrence of the efflorescence varied from two days to more than two weeks. Goodhart, after a careful examination of these cases, came to the conclusion that they were for the most part examples of true scarlet fever, especially as a considerable proportion of them occurred in groups, and there was a known exposure of some of the patients to children admitted into the hospital with the sequelæ of scarlet fever.

In the *British Med. Jour.* for Jan., 1879, George May, Jr., reported a case of efflorescence in surgical practice which appears to have been scarlatinous. A child was operated on for the radical cure of hernia on Dec. 4th. Toward the close of the same day he became restless, vomited, and his pulse on the following day rose to 136. Forty-eight hours after the operation a rash appeared on the chest and arms, the abdomen became tense and painful, and on the following day he died. The poison, however, in this case may have been septic.

Hillier remarks (*Diseases of Children*): "In the hospital for sick children, of the children who contract scarlatina a very large proportion have been the subjects of a surgical operation within a week before the rash appears." Gee says (Reynolds's *System of Medicine*): "It has been doubted by some whether the scarlatiniform rash which sometimes follows operations is really scarlatinal. The eruption appears from the second to the sixth day after the operation, and, in the cases which have caused the doubt, is very fugitive and the first and only symptom. Yet that the disease really is scarlet fever would seem to be proved by the following observations: first, that the disease occurs in epidemics; secondly, that in a given epidemic a severe case occasionally relieves the monotonous recurrence of the very mild form; thirdly, that a precisely similar scarlatinilla attacks in the same epidemic patients who have not been subjected to operation and who have no open sores; and lastly, by way of a veritable experimentum crucis, that, however freely the patients are exposed to ordinary scarlet-fever contagion afterward, they do not contract that disease." Paget and other distinguished London surgeons who have observed this complication of surgical cases believe that the patients have been previously exposed to the scarlatinous poison, and that the surgical diseases or operations furnish favorable conditions for the occurrence of scarlet fever, so that the exposure, which probably would have been without result in ordinary health, causes an outbreak of the malady.

Those who have reported cases of this form of efflorescence have for the most part neglected to state whether the patients had had scarlet fever previously, knowledge of which would have aided in the diagnosis; but from an examination of the histories of cases, especially those published in the London journals in the last four or five years, there can, I think, be little doubt that surgical maladies of a certain kind, especially traumatism, do produce a state of system which predisposes to scarlet fever, so that this class of patients are especially liable to contract it. Therefore, in my opinion, a considerable proportion of reported cases of surgical scarlatina are genuine, but in a considerable number, perhaps an equal number, of such cases the histories and symptoms indicated a septic rather than scarlatinous efflorescence, and in not a few instances, when consultations have been held, opinions differed, some diagnosticating scarlet fever, others septicæmia. In some of the cases I find it stated that the fauces presented the normal appearance. Now, faucial redness is so generally present in scarlet fever, antedating that of the skin and coexisting with it, that its absence is strong evidence that the disease is not scarlatinous. Moreover, when, as was true of certain of the reported cases, the rash appeared irregularly upon the surface, and faded away in two or three days with the abatement of the fever, and the conditions of septic absorption were present, the efflorescence was probably septicæmic.

The following were apparently cases of septicæmic efflorescence: A child aged five years (*Brit. Med. Jour.*, Feb. 15, 1879) had inflammation of the lymphatic glands in the groin, which suppurated. At the time when the abscess was fully formed a rash appeared over the entire body. It consisted of numerous red points, but was paler than that of ordinary scarlet fever; temperature never above 99°; no sore throat nor desquamation of cuticle. No child exposed to her took scarlet fever, and her sickness could not be traced to infection. In the *British Med. Jour.*, Jan. 4, 1879, L. Braxton Hicks states that his son, attending school at Reading, was seized with a severe attack of pyrexia, accompanied on the second day by delirium and the occurrence of a rash like scarlet fever over the entire surface. He had no decided redness of the fauces, though it was perhaps slightly flushed. The right buttock was swollen from inflammation, and a large, deep-seated abscess formed near the tuberosity of the ischium. When the delirium abated the boy said that he was standing the day before the fever began with his legs far apart, when a schoolfellow stretched them farther by suddenly pulling on one of them. The rash, which was nearly universal, lasted three days, and was not followed by desquamation. No case of scarlet fever occurred in the school before or afterward. In the same volume of the *British Medical Journal*, Surgeon Frolliott, of the East India Service, relates the case of a private, aged twenty-three years, and three years in India, who, when on duty in the Punjab, was injured by the explosion of an Afghan powder-magazine. The accident occurred Dec. 21, 1878. On Dec. 25th a bright scarlet rash appeared upon the abdomen and spread over the entire body. The following day the eruption was very vivid, like a boiled lobster, and it lasted five days. The temperature, which in the beginning had been 101°, abated to the normal after the rash appeared. No soreness of throat nor redness of the buccal surface occurred, but the epidermis desquamated, even from the palms of the hands and soles of the feet. Now, the febrile movement of scarlet fever does not cease while the efflorescence is distinct. It does not even diminish when the eruption appears, while in the above case it fell to the normal—a common occurrence in septicæmia, even when the blood-poisoning is profound. Moreover, scarlet fever is so rare in India that Frolliott, after twelve years' service, had only heard of one case among Europeans and natives. The surgeons who consulted over the case of this private disagreed in opinion, some regarding the disease as septicæmic, others as scarlatinous. But a better knowledge of the clinical history of scarlet fever on the part of these army surgeons would, I think, have removed all doubt as to the diagnosis.

It is the opinion of some reputable surgeons that the exposure of traumatic patients to the scarlatinous poison sometimes aggravates the inflammation of wounds, causing them to assume an unhealthy appearance, even though no scarlatina be produced. The late Dr. Solly made the remark, "Whenever a case of surgery in private practice takes on a highly phlegmonous appearance, I am always sure to find break out, in the inmates of the house, either erysipelas or scarlet fever" (*British Med. Jour.*, Feb. 15, 1879). We will see that the scarlatinous poison sometimes causes pharyngitis or nephritis without producing the general disease. In a similar manner it seems that it may aggravate open wounds, intensifying the inflammation in them, while there is no efflorescence or other symptom to show that scarlatina itself is present. The poison appears to act entirely locally in such cases.

Paget, in his *Clinical Lectures*, says: "I think it not improbable that in some cases results occurring with obscure symptoms within two or three days after operations have been due to the scarlet-fever poison, hindered in some way from its usual progress." Playfair, in his remarks on the puerperal state, adds: "Mr. Spencer Wells informs me that he has seen cases of surgical pyemia which he had reason to believe originated in the scarlatinal poison; and his well-known success as an ovariotomist is no doubt, in a great measure, to be attributed to his extreme care in seeing that no one likely to come in contact with his patients has been exposed to any such source of infection." Opinions like these, held by such prominent members of the profession and sustained by many observations, should certainly induce physicians to prevent, as far as possible, exposure of their surgical patients, especially if they have sores or wounds, whether by traumatism or scalpel, to the scarlatinal poison.

OBSTETRICAL SCARLATINA.

Women during convalescence after childbirth are very liable to contract scarlet fever. In the New York Infant Asylum, which has maternity wards, a woman was admitted from a house in which scarlet fever was prevailing, and assigned to a cot next that occupied by one of the waiting-women, who was confined soon afterward. Her labor was favorable, but three days afterward she took scarlet fever, and another lying-in patient contracted it from her. The sore throat and desquamation were characteristic. It has come to my knowledge that a physician of New York, in whose family scarlet fever was occurring, attended three women in succession in their confinement, and all contracted scarlet fever, which presented the characteristic symptoms, and two of them died. Experienced and cautious physicians of New York, aware of the danger, do not go directly from a scarlatinous patient to an obstetrical case, but avoid the risk by intermediate visits to other patients or by remaining for a time in the open air. As an additional precaution, I never attend a case of midwifery without first soaking my fingers in a solution of corrosive sublimate.

Playfair, remarking on this subject, says: "There is good reason to believe that the contagium of zymotic diseases may produce a form of disease indistinguishable from ordinary puerperal septicæmia, and presenting none of the characteristic features of the specific complaint from which the contagium was derived. This is admitted to be a fact by the majority of our most eminent British obstetricians, although it does not seem to be allowed by continental authorities, and it is strongly controverted by some writers in this country. It is certainly difficult to reconcile this with the theory of septicæmia, and we are not in a position to give a satisfactory explanation of it. I believe, however, that the evidence in favor of the possibility of puerperal septicæmia originating in this way is too strong to be assailable. The scarlatinal poison is that regarding which the greatest number of observations has been made. Numerous cases of this kind are to be found scattered through our obstetric literature, but the largest number are to be met with in a paper by Braxton Hicks. Out of 68 cases of puerperal disease seen in consultation, no less than 37 were distinctly traceable to the scarlatinal poison. Of these, 20 had the characteristic rash of the disease, but the remaining 17, although the history clearly proved exposure to the contagium of scarlet fever, showed none of its usual symptoms, and were not to be distinguished from ordinary typical cases of the so-called puerperal fever. On the theory that it is impossible for the specific contagious diseases to be modified by the puerperal state, we have to admit that one physician met with 17 cases of puerperal septicæmia in which, by a mere coincidence, the contagion of scarlet fever had been traced, and that the disease nevertheless originated from some other source—an hypothesis so improbable that its mere mention carries its own refutation."

Parturition, like traumatism, furnishes in an eminent degree the conditions in which septic poisoning occurs, and the efflorescence which often accompanies septicæmia bears, as we have seen, a very close resemblance to that of scarlet fever. Hence in many instances the same difficulty is present in making a differential diagnosis between septic and scarlatinous blood-poisoning in obstetrical cases which occurs in surgical practice. But, according to my observations, an efflorescence occurring during the week following parturition is in most instances septic. It is only in exceptional cases that it is scarlatinous. But if, as Playfair believes, the scarlatinal poison sometimes produces in parturient women a puerperal fever in which the characteristic scarlatinal symptoms are lacking, and which, in the present state of our knowledge, is not distinguishable from ordinary septic fever, certainly the scarlatinous virus sustains a more frequent causal relation to childbed fever than has been heretofore supposed.

AGE.—Infants under the age of six months do not ordinarily contract scarlet fever, although fully exposed, and those under four months nearly possess immunity. Still, this disease has been observed in new-born infants, contracted, apparently, through the placental circulation. Tourtual states that a woman waited upon her own husband and child, both of whom had scarlet fever, during the eighth and ninth months of her pregnancy till near her confinement. Though she had no symptoms of scarlet fever, her infant had unusual redness of the skin and buccal surface and difficulty of swallowing up to the fifth day. On the ninth day desquamation began, and at a later stage the nails of the fingers and toes separated. A case having a history in some respects similar is related by Megnert, but the symptoms were anomalous for scarlet fever, and the disease may have been ordinary septic fever. On the other hand, in one instance in my practice a mother had scarlet fever, beginning about the third day after her confinement, and although she suckled her infant and it was constantly in bed with her, it had no symptoms of scarlet fever, but became affected immediately afterward by a severe form of eczema, probably from the altered quality of the milk; and in two instances observed by Murchison new-born infants remained healthy, although their mothers suffered from scarlet fever.

After the age of six months the liability to scarlet fever increases till the close of infancy, children between the ages of six months and one year being less liable to contract the malady than during the second year, and those in the second year being less liable to it than those in the third year. Murchison collected the statistics of deaths from scarlet fever in England and Wales during a series of years ending with 1861. The number of deaths aggregated 148,829, and the percentage of deaths at different ages was as follows:

Deaths under 1 year	6.7	per cent.
" between 1 and 2 years	14.09	"
" " 2 and 3 "	16.00	"
" " 3 and 4 "	15.13	"
" " 4 and 5 "	11.9	"
" " 5 and 10 "	25.9	"
" " 10 and 15 "	5.8	"
" " 15 and 25 "	2.6	"
" " 25 and 35 "	0.8	"
" over the age of 35 "	0.8	"

Among the deaths were 10 cases above the age of 85 years, so that scarlet fever, though especially a disease of childhood, may occur in any decade of life; but old age, like early infancy, almost possesses immunity from it.

I have preserved the records of the ages of 145 consecutive cases occurring in private practice. If we add to these 58 cases observed by Prof. Octerlony (*Amer. Jour. of Med. Sci.*, July, 1882), we have the statistics of the ages of 203 cases, which are embraced in the following table:

Under 1 year	3
From 1 to 2 years	25
" 2 to 3 "	43
" 3 to 5 "	57
" 5 to 10 "	53
" 10 to 15 "	13
" 15 to 20 "	3
" 20 to 30 "	4
" 30 to 40 "	2
Total	203

Clinical Facts regarding Scarlet Fever.

As a rule, scarlet fever occurs but once, one attack conferring immunity from the disease for life; but there are exceptions. In 1860, I attended a child with fatal scarlet fever who three years previously, it was stated, had passed through a first attack with all the characteristic symptoms. The following case occurred in a family attended by the late Dr. Herzog: R——, a boy of six years, had scarlet fever in a mild form in January and February, 1875, followed by moderate desquamation. In July of the same year he was kicked by a horse in the street, receiving a deep scalp-wound which required stitching. Three days afterward he had, to appearance, a second attack of scarlet fever, attended by high febrile movement and followed also by desquamation. It was believed by Dr. H. to be a genuine case, and was so treated. I am not able to state as regards the presence of soreness of the throat, and doubt arises whether the second attack may not have been septicæmic. In April, 1876, a third attack occurred, which I saw from the beginning. It was accompanied by all the characteristic symptoms—injection of the fauces, an efflorescence continuing the usual time, followed by desquamation and albuminuria, the latter remaining several weeks. Richardson states that three distinct attacks occurred in his own person, and a student attending the lecture at which this was mentioned informed the doctor that he also had scarlet fever three times.

Sometimes a second attack occurs so soon after the first that it has been described as a relapse. The following was a case in point in the practice of Godneff (*Meditz. Vestnik.*, No. iv., *N. Y. Med. Rec.*, April 30, 1881): A youth of seventeen years contracted scarlet fever while taking care of a child. It began with a chill, and he had the usual efflorescence, sore throat, and tumefaction of the cervical glands. An exudation appeared upon his tonsils and uvula, and his temperature reached 104°. The urine contained a trace of albumen; the rash in due time faded; and the epidermis exfoliated. On the fifteenth day, when he was about ready to leave the hospital, he again had a chill, followed by fever. The temperature reached 105.2°, the rash reappeared over the entire surface except the face, diphtheritic exudations occurred upon the fauces, and the urine, the quantity of which was diminished, again became albuminous. The second efflorescence faded on the twenty-fourth day, and on the twenty-seventh exfoliation began. Hillier says: "I have seen a young woman in the fever hospital suffering from a second attack of scarlatina, the first attack having occurred five weeks previously. She had quite recovered from her first illness, and was acting as nurse. In both seizures the rash, the sore throat, and other symptoms were characteristic. The relapse or recurrence was less severe than the primary disease." Cases of a fourth attack, or even of a greater number, have been reported. The first seizure is sometimes milder, but in other instances is more severe, than those which follow.

Exposure to the scarlatinous poison not infrequently produces pharyngitis without the occurrence of scarlatina, and the inflammation is usually severe, accompanied by pain in swallowing and marked febrile movement. This phlegmasia is distinguished from scarlet fever by its shorter duration and the absence of the efflorescence. It occurs in adults as well as in children, and in those who have had, as well as in those who have not had, scarlatina. So far as I have observed, it is very seldom accompanied or followed by any of the complications or sequelæ so common in and after scarlet fever. It cannot be distinguished from ordinary pharyngitis except in the manner in which it occurs, and one attack does not preclude another. The late George B. Wood made the remark that he never attended a case of scarlet fever without suffering from sore throat. The following were examples of this form of pharyngitis: On Jan. 17, 1882, I was called to a boy of three years with severe scarlet fever, ushered in by convulsions. On the following day his sister, aged seven and three-fourths years, whom I had attended a year previously during a severe attack of scarlatina, and who had been almost constantly with the brother, became very ill, with a temperature of 103.5°. Examination revealed severe inflammation of the fauces, without pseudomembrane or any other exudation except muco-pus. On Jan. 19th an older brother, nine years, whom I had attended in scarlet fever three years previously, was affected in the same way, his temperature being 104° and his respiration guttural and noisy, especially during sleep, in consequence of the great amount of faucial swelling. At times he was delirious. The inflammation in both cases began to abate about the third day, and had disappeared by the close of the week. That the contagium of scarlet fever may be received into the system and cause pharyngitis while the patient has immunity from scarlet fever through a previous attack, and that this inflammation may occur any number of times, as in the case of Dr. Wood, are remarkable facts.

Now and then cases occur which appear to show that the scarlatinous poison may affect the kidneys, producing nephritis, while there is no other manifestation of its influence. Thus in my practice a lady of about forty-five years constantly attended her son, sleeping by his side, during an attack of scarlet fever. Her health had previously been good. When the boy was convalescent, as her appetite failed and she was indisposed, a careful examination revealed the fact that she had albuminuria, although she had had no sore throat or other symptoms of scarlet fever. After several weeks of treatment her disease was removed, and she has remained well since. In the *British Med. Jour.* for Nov. 29, 1879, it is stated that in a family four girls were found to be suffering from desquamative nephritis. One of them had recently had scarlet fever, but the other three had presented no symptoms whatever of this disease. Such cases, although probably rare, appear to show that, as the scarlatinous poison may produce inflammation of the fauces without the occurrence of scarlet fever, so it may cause nephritis without producing the general disease, or apparently disturbing the functions or changing the state of other parts, except the kidneys.

SYMPTOMS.—*Ordinary Form.*—Scarlet fever usually begins abruptly, so that the exact time of its commencement can be fixed. If any premonitory symptoms occur, they are slight, so as scarcely to attract attention, as languor or the appearance of fatigue. A dusky aspect of the surface may occasionally be observed during the few hours preceding the attack. In some children the first symptom is chilliness, and occasionally a distinct chill occurs. In the adult a chill is ordinarily the first symptom. With or without the initial chilliness fever occurs, of variable intensity according to the severity of the type, and accompanied by such symptoms as usually arise in a febrile state of system, as cephalalgia, anorexia, and thirst. The pulse rises to 110, 120, or more per minute, the temperature to 102°, 103°, or 104°; the skin is hot, face flushed, and the eyes bright. Even in cases that are not malignant or grave, and that give indications of a favorable result, there is often more or less stupor, with transient delirium and sudden starting or twitching of the extremities, showing that the cerebro-spinal axis is involved.

Vomiting is a common symptom in the beginning of scarlet fever, occurring before the appearance of the efflorescence. It therefore has diagnostic value when the nature of the case is still doubtful. In some patients it is an initial symptom, but in others some hours have elapsed when it occurs. I recorded its presence or absence in 214 patients, with the following result: present in 162 patients, absent in 52. In severe forms of the disease it is rarely absent, and if it do not occur it is probable that the case will be mild, requiring little treatment and having a favorable termination. In epidemics of unusual mildness the number of cases without vomiting may be in excess of those in which this symptom occurs. It appears to be due to functional disturbance of the cerebro-spinal system, and may therefore be properly regarded as a nervous symptom. In severe cases the vomiting is usually repeated, not only on the first but on subsequent days, and we shall see that in cases of great gravity, in which a fatal termination is not improbable, persistent vomiting, by which the food and stimulants so urgently required are rejected, interferes seriously with successful treatment. In a few cases

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embraced in my statistics nausea without vomiting was recorded. The bowels in ordinary scarlatina act regularly or are slightly constipated. Diarrhœa, which so commonly accompanies the persistent vomiting in malignant cases, if it occur in this form of the malady is slight and transient and due to accidental causes. The food, if it be given in the liquid form and cool, is usually taken readily on account of the thirst, except when deglutition is rendered painful by the pharyngitis.

The symptoms pertaining to the nervous system vary according to the severity of the disease and the temperament of the patient. Many children during the progress of the common form of scarlet fever present a dull or apathetic appearance. They lie much of the time with their eyes closed; others are more restless, and not a few, if the fever be considerable, have occasional twitchings of the limbs and more or less headache. Eclampsia sometimes occurs on the first day, especially in those predisposed to it, even when the subsequent course of the disease is mild and favorable. This complication, very grave and usually fatal when it occurs at a later stage, is in most instances, when it takes place on the first day, readily controlled by proper remedies and with little detriment to the patient. But if it be attended by high elevation of temperature and marked drowsiness, approaching the comatose state, it is very serious upon the first as well as upon the subsequent days. Nervous symptoms occurring in the beginning of scarlet fever, when it has the ordinary favorable type, begin to abate in three or four days, but if they supervene at a later date, and especially in the declining stage, they possess more gravity, since they then not infrequently result from and indicate renal complication.

Early in the disease, nearly as soon as the commencement of the fever, the faucial and buccal surfaces become inflamed, as shown by redness, swelling, and tenderness. The physician summoned in the beginning of an attack will already, at his first visit, observe hyperæmia of the fauces, with points of deeper injection than over the general faucial surface, and soon the buccal surface also participates. The inflammation at first produces preternatural dryness, and this is followed by a viscid secretion. The papillæ of the tongue enlarge and become prominent, giving rise to the appearance known as strawberry tongue which is so common in scarlet fever. This state of the buccal and faucial membrane continues throughout the disease. A thin fur appears upon the tongue on the first day, and it increases on the second and third days, after which it is usually detached, exposing the surface of the organ, which has a deep-red hue, but in not a few patients the fur remains or is reproduced as soon as shed. Except in the mildest cases the Schneiderian membrane also participates in the inflammation as the disease advances, so that a thin, irritating discharge containing leucocytes or pus-cells flows from the nostrils. The skin is hot and dry and cutaneous transpiration is nearly checked. The respiratory system is rarely involved in any notable manner unless there be a complication. Many have no cough whatever, while others have a slight cough, due to the fact that the inflammation of a catarrhal form has extended from the fauces to the surface of the glottis. Slight acceleration of respiration, corresponding with the degree of fever, may also be observed. The kidneys commonly act regularly and normally during the first days, any serious impairment of their functions being rare before the close of the first week.

When the symptoms described above have continued from six to eighteen hours the efflorescence appears. It is first observed about the ears, neck, and shoulders in reddish patches fading into the normal hue. These patches extend and unite, and in the course of a few hours the trunk and upper extremities, and finally the legs, are covered. The scarlatinous rash usually, when fully developed, resembles that produced by external heat or the application of a sinapism. It has been likened to the appearance of a boiled lobster, but there are numerous minute points of a deeper or duskier hue than the surface generally. In many patients the rash appears, especially over the abdomen and lower extremities, as minute, thickly-set points, with the skin of normal appearance between them. Henoch of Berlin says of scarlet fever: "In general, the moderate grades of eruption prevail, the skin, when seen from a distance, presenting a diffuse, more or less scarlet redness, while on closer inspection it is found that this redness is composed of innumerable red points closely situated together, and separated from one another by very small paler portions of skin. The dark-red points appear to correspond to the hair-follicles." On passing the finger over the efflorescence no distinct prominences are observed, but a sensation of roughness is sometimes imparted from engorgement of the cutaneous papillæ. The rash disappears on pressure, but it immediately reappears when the pressure is removed. Its slow return is evidence of sluggish circulation, and it indicates a grave and dangerous form of the malady. The color is then usually a dusky instead of a bright red. The efflorescence is most marked in dependent parts, as along the back, over the chest and abdomen, and in the flexures of the joints. Parts pressed upon by the bedclothes, which confine and intensify the heat, present a deeper coloration than other portions of the surface. Often, especially in mild cases, the rash is absent from portions of the surface where it commonly appears, while it presents its typical character elsewhere. Tardy and incomplete establishment of the rash when the symptoms indicate an attack of ordinary or more than ordinary severity is commonly due to some perturbating cause, especially diarrhœa. In the *London Lancet* for Aug. 16, 1879, cases are related of supposed scarlet fever without the rash—cases in which pharyngitis and stomatitis with the strawberry tongue occurred, without efflorescence upon the skin; but it is to be remembered, as stated above, that the inflammations which commonly attend or follow scarlet fever, particularly the pharyngitis and nephritis, not infrequently occur in those who have already had scarlatina, and occur more than once from fresh exposure to scarlatina patients. These inflammations, occurring under such circumstances, appear to be purely local maladies, produced by the scarlatinous virus; and it seems to me a question whether, in the so-called scarlatina without efflorescence, the inflammations which are present, and which undoubtedly have a scarlatinous origin, are not local in their nature, instead of being local manifestations of the constitutional disease. The burning and itching sensation produced by the rash increases the restlessness of the patient, and is sometimes the most annoying of the symptoms.

The temperature in the common favorable forms of scarlet fever usually varies from 101° in the mildest cases to 103° or 104° in those more severe. If it attain 105° or over, the case is properly designated grave or severe. The febrile movement ordinarily fluctuates but little from day to day till the fourth or fifth day, when, if the case be favorable and no complication occur, it begins to decline. The temperature is as high in the beginning of the attack as subsequently.

The symptoms pertaining to the digestive system during the initial period of scarlet fever have been sufficiently described. The subsequent symptoms referable to this system do not differ materially from those present in the beginning, except the absence of vomiting. The lips are dry and often cracked. The inflammation of the mouth and throat continues, with anorexia and thirst. With the decline of the disease the appetite gradually returns, but it is not till the close of the second week that it is fully restored. Great and continued disturbance of the digestive apparatus, seriously interfering with the nutrition, pertains to the malignant forms of scarlet fever.

The urine is high-colored, and in robust children during the first days of scarlet fever it frequently deposits urates on cooling. Gee, who has carefully investigated the state of the urine in scarlet fever, says that the quantity of water is diminished and the urea is not necessarily increased during the pyrexia; that the chloride of sodium is diminished till the fourth, fifth, or sixth day; and that the phosphoric acid is diminished during the climax of the pyrexia, though not in the first three or four days. In one case he made a daily estimation of the amount of uric acid, and found it greatly diminished on the second and third days, normal on the fourth, and much increased on the fifth. He believes that similar variations are common in the quantity of the products excreted in the urine. Bile may also appear in the urine, coincident with a yellow tinge of the conjunctiva.[1]

The duration of scarlet fever varies in different cases. If the attack be very mild, with little efflorescence, the febrile movement may decline by the fourth or fifth day; but if the disease be severe, little or no amelioration of symptoms may occur before the twelfth or fourteenth day, even when no complication has occurred to increase the temperature or cause aggravation of symptoms. Octerlony, who estimated the duration of scarlet fever from the commencement of febrile symptoms to "the disappearance of fever, with marked improvement in leading symptoms," . . . . "found that the average duration of the disease in forty cases was six and one-sixth days. The minimum duration in a very slightly marked case was three days: the maximum duration was fourteen days." In general, prolongation of fever beyond the usual time is due to some complication—more frequently to unusually severe pharyngitis, with accompanying cellulitis, than to any other cause.

The malady whose commencement was so abrupt declines gradually. In ordinary cases, by the close of the first week or in the beginning of the second the rash becomes less and less distinct, and finally disappears, as do also the redness and swelling of the buccal and faucial surfaces. The engorgement of the tonsils and of the papillæ of the tongue subsides, the appetite returns, the countenance brightens and becomes natural, and the child, who during the height of the fever scarcely noticed objects or noticed them with indifference or even repugnance, can be amused as before his sickness.

Desquamation succeeds. This begins at about the sixth day, and is not completed till the tenth or twelfth day, often not till the close of the third or in the fourth week. The amount of desquamation corresponds with the intensity and duration of the efflorescence, or rather of the dermatitis which produces the efflorescence. If the efflorescence have been slight and partial, it will be slight, perhaps scarcely appreciable, but if the rash have been general, full, and protracted, exfoliation occurs upon every part. It begins about the face and neck, and within a day or two appears upon other parts. Where the skin is thin the epidermis as it is detached presents a furfuraceous appearance; where it is thick, as upon the palms of the hands or soles of the feet, it separates in layers of considerable thickness.

Such is a brief description of scarlet fever when it pursues its normal course without any disturbing element, but there is no other disease in which complications and sequelæ so frequently occur. The liability to them renders the prognosis in every case doubtful. They largely increase the percentage of deaths. They occur both in mild and severe forms of scarlatina.

The difference in type in different cases and epidemics has already been alluded to. Scarlet fever is sometimes so mild and its symptoms so slight that the diagnosis is necessarily uncertain. In the spring of 1866, I was called to an infant thirteen months old who had slight pharyngitis and an indistinct rash over a part of the surface. In two days the eruption had disappeared, and the health within a day or two was apparently fully restored. Diagnosis would have been doubtful except for sequelæ which clearly indicated the scarlatinous nature of the attack. In another instance two children passed through the entire course of scarlet fever, playing every day in the street. Although the intelligent grandmother saw the rash upon them, its nature was not suspected, as it was midsummer and cases of prickly heat common, till nearly two weeks afterward, when one of the children had nephritis and anasarca, ending fatally. In cases so mild as these the heat of the surface is but slightly increased, the pulse but little accelerated, and the rash usually does not occupy so much of the surface as in ordinary cases; the appetite is not lost, though diminished, and the thirst is moderate.

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[1] Article on Scarlatina in Reynolds's *System of Medicine*.

Between scarlet fever so mild that it terminates in four or five days, and that of the grave or malignant type presently to be described, all grades of severity exist. Scarlet fever occurs in all forms from mild to severe, but certain symptoms characterize grave or malignant cases—symptoms which are absent or much less prominent in ordinary scarlet fever. Therefore the grouping of cases according to the type is proper, and it facilitates the studying of the disease.

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Grave Form (malignant scarlet fever).—This form of the disease is in some epidemics common, while in others it is rare. The symptoms which characterize it are severe from the beginning, those of the nervous system predominating at first, such as intense cephalalgia, restlessness or stupor, sudden twitching of the muscles, and perhaps delirium or even convulsions. Many pass rapidly into coma and die within two or three days, succumbing to the intensity of the scarlatinous poison while the malady is still in its commencement. The rash is dusky. It disappears by pressure, and returns slowly when the pressure is removed, showing extreme sluggishness of the capillary circulation. Some patients are very drowsy, lying in a semi-comatose state except when aroused, and if aroused are very restless. Others are constantly restless. If placed in one position on the bed, they throw themselves in another in a half-conscious or unconscious state. They do not speak, or they mutter like those affected by the graver forms of typhus, calling the names of playmates or talking incoherently about things which interested them when well. The theremometer placed in the axilla is found to rise above 103°, which is a safe average, to 105° or even 107°, and the heat of the surface is pungent except when the case approaches a fatal termination, when the extremities, ears, and nose may be cool while the trunk and head are extremely hot. The pulse from the first is rapid, ranging from 130 as the minimum in a malignant case to a frequency which can scarcely be counted. A very frequent pulse is nearly always feeble and compressible. Irritability of the stomach is one of the most common symptoms in grave cases, so that many patients immediately reject the nutriment and stimulants which are so urgently required to sustain the vital powers. The vomiting, therefore, if frequent and severe, greatly increases the danger, and in not a few instances this symptom is associated with diarrhœa, which also tends to increase the prostration.

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Severe and dangerous nervous symptoms, due to the intensity or activity of the scarlatinous poison, occur chiefly within the first three or four days. Grinding the teeth, sudden muscular twitching, delirium, convulsions, and profound stupor occur for the most part within this time. Afterward the danger is mainly from exhaustion, unless in the second week or subsequently, when nervous symptoms may arise from uræmia.

Those who survive the onset of malignant scarlet fever often have in the course of a few days severe pharyngitis, with extension of the inflammation to the lymphatic glands and connective tissue around the angle of the jaw. These inflammations cause more or less external swelling. The faucial turgescence around the entrance of the larynx, with the accompanying secretions of viscid mucus or muco-pus, often causes noisy respiration, and many at this stage of the attack breathe with the mouth constantly open to facilitate the ingress of air.

Ordinarily, no discharge occurs at first from the nasal surface, but as the disease continues, if the type remain severe, defluxion of thin muco-pus takes place from the Schneiderian surface, which excoriates the cheek. The lips also are frequently sore and swollen.

In malignant cases the disease is more protracted than when the type is mild. Thus in a recent case in my practice the rash was still distinct at the close of the second week, though the temperature had fallen from 105° to 102°, and some desquamation had appeared. Long continuance of the febrile movement is, however, oftener attributable to some inflammatory complication than to the primary disease.

In all epidemics of a severe type cases now and then occur in which the poison is so intense, or it acts with such frightful energy, that death occurs even within the first day. The patient is overpowered at the outset of the disease by the virulence of the specific principle, perishing in coma, preceded perhaps by convulsions. The autopsy in such cases reveals hyperæmia of the brain and cranial sinuses, blood of a dark-red color, capillary hemorrhages in various parts, a flabby heart, and perhaps some engorgement of the spleen and kidneys.

Usually, malignant scarlet fever exhibits its severe type from the first, but cases sometimes occur which seem mild and favorable for a few days, when severe symptoms suddenly supervene. This change from a mild to a dangerous disease is, however, most frequently, I think, due to some complication.

Irregular Forms.—Deviation from the normal type in scarlet fever is usually due to some perturbating cause, which is often a pre-existing or coexisting disease or a disordered state of system through causes distinct from scarlatina. Thus, a little girl in my practice had the symptoms of scarlet fever, such as febrile movement and inflammation of the buccal and faucial surfaces, nearly a week before the scarlatinous eruption appeared. During this time the patient had an intestinal catarrh, with diarrhœa, which declined when the rash occurred. This intestinal disease was the apparent cause of the irregularity in the malady. If scarlatina occur during a severe attack of entero-colitis attended by purging, the defluxion from the intestinal surface may be such that no efflorescence appears. Severe scarlet fever itself sometimes appears to cause gastro-intestinal catarrh, so as to produce an afflux of blood toward the intestinal tract and away from the skin. Practitioners occasionally meet cases like the following, which I recall to mind: In a family where scarlatina was prevailing a little child early after the commencement of the symptoms which seemed to be plainly referable to this exanthem was seized with vomiting and purging, which continued till death occurred on the third day. No efflorescence appeared on the skin, but the symptoms indicated the presence of severe intestinal catarrh, complicating and masking scarlatina. We are aided in the diagnosis of such cases by observing the faucial redness, and we may discover a faint efflorescence upon parts of the surface, as about the groin or in the flexures of the joints. In another instance an infant in the warm months, having protracted entero-colitis, the usual summer epidemic of the cities, had the characteristic symptoms of scarlet fever, which was present in the family, but the diarrhœa continued and no rash appeared.

In one who is much reduced by an antecedent disease, especially if, like the intestinal catarrh mentioned above, it produces a decided afflux of blood away from the surface and toward the interior of the body, the eruption is commonly tardy in its appearance, indistinct, or wholly absent. On the other hand, some maladies occurring in connection with this exanthem do not change its symptoms, but themselves undergo modification. Pertussis may be cited as an example, the cough of which is sometimes modified by an intercurrent attack of scarlet fever, the symptoms of the latter disease undergoing little change.

Scarlet fever may also be irregular without any apparent perturbating cause. In 1867, I attended a young lady whose previous health had been good, and whose brother was sick at the time with scarlet fever. She had marked elevation of temperature, with severe pharyngitis, and, though her surface was repeatedly examined, no efflorescence was seen. Two weeks subsequently she was affected with severe nephritis, anasarca, effusion into at least one of the pleural cavities, œdema of the lungs, and, according to my diagnosis, hydro-pericardium, the case ending fatally. Rilliet and Barthez state that a second attack of scarlet fever is more likely to be irregular than the first. Probably this opinion is correct, especially if only a short time have elapsed between the two seizures. Still, as we have already stated, both seizures may be typical, and the second more severe than the first.

It would be impossible to make a clear and positive diagnosis of certain cases of irregular scarlet fever, in which cerebral, pulmonary, or gastro-intestinal symptoms predominate, were it not for the fact that they occur in connection with other cases of scarlet fever or are followed by sequelæ which evidently have a scarlatinous origin.

Occasionally, the eruption, if it be intense or if a certain condition of system be present in the patient, is accompanied by more or less extravasation of blood-corpuscles from the capillaries, usually in points, so that the redness does not entirely disappear on pressure. In rare instances certain of the exanthematic fevers present an extreme hemorrhagic character, so as to be beyond the reach of remedies and of necessity speedily fatal. Hemorrhagic cases of this severe form are probably more common in variola than in the other fevers, but I have met a notable case in what was diagnosticated scarlatina. In June, 1881, a man in his thirty-second year, whose previous health had not been good, though he had no defined ailment and had been able to follow his occupation of harness-maker, suddenly became very ill, with great elevation of temperature and faucial inflammation, attended by marked prostration. After some hours an intense eruption of a scarlatinous appearance covered nearly the entire surface, and on the following day hemorrhages began to occur. The urine contained a large proportion of blood; each conjunctiva was raised by hemorrhages underneath (ecchymosis), so that its natural color was lost, the eyelids were closed with difficulty, and blood flowed from the nostrils, gums, and under the skin, forming hemorrhagic points and blotches. One of the consulting physicians, perceiving the resemblance to hemorrhagic variola as described by Hebra, suspected that we had a case of this formidable malady to deal with, but the time for the appearance of the variolous eruption passed by without its occurrence. Death took place on the fifth day. The temperature during the sickness remained high, though the record of it has been mislaid. Fortunately, such severe hemorrhagic cases, which are necessarily fatal, are rare.

Complications and Sequelæ.—Scarlet fever, if its type be severe, is in itself dangerous to life. Many, as we have seen, perish from its direct effects when it produces profound blood-poisoning. But, while the ordinary epidemics of this malady are necessarily attended by a large mortality from the virulence and depressing effect of the specific principle, unfortunately, of all the diseases of modern times, scarlatina ranks first as regards the number and gravity of its complications and sequelæ, so that nearly or quite as many perish from these as from the direct effects of the poison.

Nervous accidents occur chiefly at two periods—to wit, in the first days, when they are due to the severity and malignancy of the malady and to the impressible nervous temperament of the child; and in the declining stage or after the termination of the fever, when they occur from uræmia. If the type be malignant, delirium, jactitation, profound stupor, and convulsions frequently occur on the first and second days; and these are symptoms which properly excite the most alarm and demand all the resources of our art, since they indicate a form of the disease which frequently ends in speedy death. The eyes have a dull or wild expression, the conjunctiva is suffused, the heat of surface pungent, the pulse rapid and compressible or feeble, rising above 150, even to 200, per minute, and the temperature is always elevated to a degree that involves danger, the thermometer not infrequently indicating 105° or 106°. But this severe form of scarlet fever, attended by so great elevation of temperature, is much less dangerous than in former times, even though it be complicated by delirium and convulsions, since we no longer hesitate to reduce bodily heat, when excessive, by the free use of cold baths, and have discovered potent agents in the bromides and chloral for controlling convulsions. Nevertheless, not a few perish in the commencement of scarlet fever with predominating cerebral symptoms, as delirium or eclampsia, followed by coma, under the best possible treatment. Sometimes the symptoms have closely simulated those of acute meningitis, and if the rash have been delayed and the sore throat is as yet slight, the physician may suspect that he is dealing with this disease; but autopsies in such cases show no inflammatory lesions, but only congestion of the cerebral and meningeal vessels.

As is stated in a preceding page, in every case of normal scarlet fever inflammation of the faucial surface is present, as indicated by redness, tenderness, and increased secretion of mucus or muco-pus. It precedes the efflorescence on the skin, and is announced by pain in swallowing and on pressure with the fingers behind and below the angles of the jaw. In that form of scarlet fever which has been designated anginose the pharyngitis is severe, and is a prominent element in the malady, the uvula, the pillars of the fauces, and the faucial surface in general being infiltrated and swollen. Nevertheless, this inflammation, with the accompanying tumefaction, is properly a part of the disease, rather than a complication, if it abate with the subsidence of the scarlet fever or begin to abate soon after, and if it produce but slight destructive change in the tissue of the neck. The secretions from the fauces may be foul and offensive; even superficial ulcerations or gangrene may occur upon the faucial surface, causing it to present a dark-brown or jagged appearance, and the tissues of the neck may be infiltrated to a certain extent, and we designate the disease a form of scarlet fever under the title anginose. But when this condition is greatly aggravated, so that extensive infiltration and swelling of the tissues of the neck occur, with an amount of ulceration or gangrene which in itself involves danger, continuing after the primary disease abates, prolonging the fever and reducing the strength, it is proper to regard the state of the throat as a complication. In addition to the pharyngitis, which is severe, as described above, the sides of the neck around the angles of the jaw become swollen, hard, and tender. The inflammation has been propagated to the deeper structures of the neck. Poisonous substances, the result of decomposition or vitiated secretions, traverse the lymphatic vessels from the faucial surface, and, being intercepted in the lymphatic glands, cause itis, and the inflammation extends from the glands to the adjacent connective tissue, which becomes hard, tender, swollen, and infiltrated with inflammatory products. This tumefaction sometimes begins by the second or third day, but it is usually about the close of the first week or in the beginning of the second week that it becomes so considerable as to constitute a source of danger and anxiety. It is in most cases bilateral, though one side may begin to swell before the other and remain larger throughout.

In severe cases of this complication the tumefaction extends from ear to ear, filling up the space below and around the angles of the jaw and under the chin. Not only is deglutition difficult, but it is difficult to open the mouth sufficiently to inspect the fauces, and attempts to do so cause much pain. The lymphatic glands, which lie in the inflamed area and participate in the inflammation, are greatly enlarged by hyperplasia, the round granular lymph-cells multiplying so abundantly that the glands increase to many times their normal size. Most of the tumefaction is, however, due to extension of the inflammation to the connective tissue of the neck. The cellulitis, which resembles that occurring in other conditions, is attended by distension of the capillaries, the abundant formation of young round cells, and transudation of serum (Billroth). A moderate amount of tumefaction may disappear by resolution, but if it be considerable it seldom abates in this way, but by the tedious and exhausting process of suppuration or gangrene. If the swelling at its most prominent point present a reddish hue, all hope of producing resolution must be abandoned; it cannot be effected by any medicine or appliance within the resources of our art. The abscess which forms is likely to be diffuse, so as to involve danger of pyæmia, unless it be soon opened and properly washed out. With the discharge of the pus the swelling gradually softens and declines. In other cases gangrene results. The vessels in the inflamed part are compressed by the inflammatory products, so that they no longer convey the blood which is required for the purpose of nutrition. It is a law of the economy that whenever the circulation ceases the tissues which receive their nutritive supply through the obstructed vessels lose their vitality. Hence gangrene occurs in all that portion of the swelling in which the circulation is arrested. The skin over it peels off, the dead tissue underneath is brown or dark, and soon, if life be prolonged, the slough begins to separate. The prognosis as regards this complication depends largely on the size of the slough. If it be large, death will probably result, since the strength of the system is already reduced by the primary disease, and the reparative process will necessarily be slow, while abundant suppuration tends to increase the exhaustion. In some of the worst cases of cervical gangrene which I have seen the slough has laid bare the muscles and vessels of the neck, producing in one case a cavity or excavation sufficiently large to admit a hen's egg. Often the slough extends under the skin, so that the deepest recesses of the cavity are not visible, and occasionally, in cases which have ended fatally in my practice, severe hemorrhage occurred from the concealed vessels. If the ulcerative or gangrenous process extends so deeply into the tissues of the neck that hemorrhages occur, death is the common result; but if the destructive action be of moderate extent and other conditions favorable, we may expect recovery through cicatrization, with perhaps some deformity by contraction of the cicatrix.

When the inflammation of the connective tissue of the neck is extensive, involving both the lateral and anterior regions of the neck, the patient is in a perilous state. The cellulitis, when extensive and accompanied by much swelling, may produce œdema of the glottis, may obstruct respiration by compressing the air-passages or the laryngeal nerves, may cause compression of the jugular veins, and thus give rise to dangerous cerebral symptoms, or may lay bare and injure important muscles and nerves, as we have seen. If the ulceration or gangrene be extensive, and death do not occur by hemorrhage from arterial or venous twigs, septic poisoning may occur, increasing still more the fatal nature of the malady.

Some cases of this complication are melancholy in the extreme, as one related by Cremen, in which ulceration of the pharynx occurred, allowing the escape of food and preventing deglutition. In severe scarlatinous pharyngitis the inflammation sometimes extends along the Eustachian tube, causing its occlusion. This accident will be considered when we treat of otitis media, another grave complication. It often also extends into the nares, causing catarrh of the Schneiderian mucous membrane, with discharge of muco-pus from the surface. Not infrequently ulceration or gangrene occurs in the faucial surface, producing more or less destruction of tissue and forming excavations, while the cutaneous surface retains its integrity and is not even reddened. The following case shows how grave the complication which we are now considering sometimes is when the external surface of the neck is not involved, and how the inflammation by extension outward from the fauces may involve the middle ear:

CASE 1.—Annie K——, aged two and a half years, an inmate of the New York Foundling Asylum, was well, except an eczema of the scalp, until the night of April 3, 1882, when she was attacked with vomiting and diarrhœa. She was feverish and drowsy, and at 2 P. M. on the 4th the scarlatinous efflorescence appeared upon her neck, body, and lower extremities; tongue coated; pharynx red; temperature (axillary) 103°; pulse 160. The symptoms and aspect indicated a grave form of the malady, and the usual sustaining treatment was ordered. On April 5th the temperature was 102°, pulse 144, tongue less coated, eruption fading, less stupor, no albumen in urine. April 6th, morning temperature 102°, pulse 160; passed a restless night; stools thin and too frequent; has grayish patches in the throat; P. M. temperature 103⅘°, pulse 150. April 7th, the diarrhœa continues, and she has a copious muco-purulent discharge from the nostrils; P. M. temperature 103⅗, pulse 160. April 10th, the temperature has continued at about 103°; the patient is very sick, with a constant foul-smelling discharge from the nostrils; breath very offensive; temperature 103.5°, pulse about 180. April 12th, general appearance a little better, but the posterior surface of the fauces is completely covered by a thick pseudo-membrane; had four loose stools last night; temperature and pulse the same as at last record; a dark, offensive, and jagged coating over the fauces, and a dark, foul discharge from the nostrils as before: examination of the chest negative. April 14th, is much prostrated; temperature 104.5°, pulse rapid and weak; respiration noisy; diminished resonance over lower two-thirds of left side of chest; ulcers upon the mouth and tongue; fauces red and ulcerated. April 17th, pulse 150, temperature 100.5°; general appearance somewhat better, but the diarrhœa continues, and patches of a diphtheritic character have appeared upon the lips; moist râles in left side of chest. The symptoms continued nearly the same until April 23d, when she died. A dull percussion sound and distinct bronchial respiration were observed in the left scapular region during the last days of her life.

Autopsy nine hours after death by the curator, Dr. W. P. Northrup: Body well nourished; the tissues have a jaundiced hue; lips sore; on turning the head to one side pus runs from the left ear and dirty muco-pus from the mouth. Brain normal; on opening the petrous portion of the left temporal bone the middle ear is found full of pus, which communicated freely with the external ear through a perforated membrana tympani; the Eustachian tube cannot be traced in the sloughy tissue, and a passage filled with pus extends from the ear to the fauces; opposite the greater cornua of the hyoid bone are two deep ulcers, each having about the diameter of a ten-cent piece, with sloughy and offensive base and sides; the left ulcer communicates by a ragged and wide sinus with a dark and sloughy cavity of about four drachms capacity; this cavity is located in the neck under the angle of the jaw, apparently occupying the site of a disintegrated gland, and it opens upon the surface of the fauces. The surface of the larynx has a dusky, dirty appearance, sprinkled with little cheesy-looking spots, and covered by a dirty, foul-appearing liquid, as if some of the ichorous pus had escaped into it from the neck; about one and a half inches below the vocal cords there is an unmistakable pseudo-membrane; below this, near the bifurcation, the trachea has a bright-red color, as if a pseudo-membrane had been peeled from it, leaving the surface raw. The detachment of a pseudo-membrane from this part, if it did occur, must have been ante-mortem, for the organ had been carefully handled in making the autopsy. Between the apex of the left lung and the median line the tissues of the neck, dissected upward, are found indurated, yellow, and giving an offensive odor, showing that the cervical cellulitis had extended downward farther than usual. The bronchial glands have undergone hyperplasia, being enlarged and hard. The right lung is normal; about one-half of the left lower lobe is consolidated, and when cut is found to be gangrenous and offensive. The liver is apparently somewhat enlarged; spleen normal in size; gastric mucous membrane has a congested appearance and is covered with mucus; mesenteric glands enlarged, pale, and firm; Peyer's patches swollen and pale; at lower end of ileum some pigmentation of these glands; in large intestine the solitary glands are enlarged, and a few of them pigmented; kidneys pale, cortex thickened, and markings indistinct. Microscopical examination: In the pia mater perhaps a little increase of cells; meninges of brain otherwise normal. The trachea shows well-marked diphtheritic inflammation; it contains a film of pseudo-membrane; evidences of inflammation occur also upon the laryngeal surface, though less marked than in the trachea. The solidified portion of the lung exhibits the ordinary lesions of broncho-pneumonia, with some interstitial change. In the kidneys we find parenchymatous nephritis, with some cell-growth in the Malpighian bodies.

The above case has been related at length, not only because it shows how severe and destructive the inflammation of the throat, extending into the tissues of the neck, sometimes is, but because four other complications or sequelæ were also present—to wit, otitis media, diphtheria, nephritis, and pneumonia. We see how formidable a disease scarlet fever sometimes is when attended by the inflammations to which it so frequently gives rise, for a child older and stronger than this, if thus affected, would inevitably have perished with the best possible treatment.

In localities where diphtheria is endemic, as in New York City and Paris, scarlet fever is often complicated by pseudo-membranous inflammation of the fauces and air-passages. In severe cases the Schneiderian as well as the faucial surface is covered with pseudo-membrane, so that it can be readily seen on inspecting the anterior nares. Occasionally, this exudation appears upon the laryngeal and tracheal surfaces, as in the case which I have related above and in others presently to be related, causing dangerous embarrassment of respiration. This complication sometimes begins almost at the commencement of scarlet fever, but in most instances it does not occur before the third or fourth day, and it sometimes does not appear till in the declining stage of the fever. When it begins it intensifies the fever and produces general aggravation of symptoms.

The elaborate treatise by Sanné of Paris on diphtheria contains a chapter entitled "Secondary Diphtheria." In it the author says, what all who are familiar with diphtheria will agree to, that secondary diphtheria does not differ in nature from the primary form, and that it exhibits a tendency "to occupy the organs which are themselves the seat of the more pronounced local determinations of the primitive malady. . . . . Diphtheria is seen in the course or sequel of numerous diseases. Some appear to have a special proclivity for engendering diphtheria; these are specific maladies: measles, scarlet fever, pertussis." Sanné's statistics relating to the seat of scarlatinous diphtheritic exudation are as follows:

Fauces alone attacked	15 cases.
Fauces with larynx attacked	4 "
Fauces with nasal fossa attacked	8 "
Fauces with larynx and nasal fossa attacked	4 "
Fauces with larynx and bronchi attacked	1 "
Fauces with nasal fossa and lips attacked	1 "
Fauces with lips and skin attacked	1 "
Fauces unaffected	3 "
Diphtheria generalized	2 "
Larynx only affected	2 "
Nasal fossa	1 "

The opinion of so good an observer as Sanné, that when in scarlet fever pseudo-membranous exudation appears upon the mucous surfaces which are the seat of scarlatinous inflammation, diphtheria has supervened, and not a croupous form of scarlatinous phlegmasia, carries with it great weight.

Nevertheless, one of the most difficult problems which we have to deal with in certain cases is to distinguish diphtheritic from non-diphtheritic inflammation; and I see no reason why the scarlatinous inflammation when intense may not be sometimes membranous. We know that in some cases of dysentery a fibrinous exudation occurs upon the surface of the colon; that in croupous pneumonia fibrin exudes into the bronchioles and alveoli of the lungs; and that physicians in localities where there is no diphtheria meet, though at long intervals, cases which they designate croupous pharyngitis and laryngitis; and it seems probable that the intense inflammation of anginose scarlatina sometimes produces the same exudation. Moreover, it is very difficult to distinguish in the swollen fauces between a membranous exudation and ulceration or superficial gangrene so common in malignant scarlet fever. The grayish-white surface, jagged and foul, may be the one or the other, an exudation or a sphacelus, and in certain instances it is impossible to discriminate between the two conditions at the bedside.

Diphtheria complicating scarlet fever occasionally begins nearly simultaneously with the latter. Henoch states that exceptionally he has observed suspicious patches upon the fauces before the appearance of the scarlatinous eruption upon the skin; and he adds: "I have had repeated opportunities of observing this unusual beginning. In such cases we must ask ourselves whether the first affection was really connected with the second, or whether the former was a true primary diphtheria rapidly followed by scarlatina. This opinion is favored by the fact that I had only observed such cases in the hospital, in which infection with various forms of contagion can scarcely be avoided."

But usually it is not till the third or fourth day of scarlet fever that this complication begins. The patient has been progressing favorably with the fever till on a certain day a marked aggravation of symptoms occurs. A higher temperature, more pungent heat, and the physiognomy of a more serious malady are present. On inspecting the fauces to discover the cause, we observe a pellicle forming upon the tonsils and perhaps other portions of the faucial surface. Often the entire aspect of the case changes by the occurrence of this complication, a mild case of scarlet fever becoming grave and fatal in consequence. Thus in a case which I saw with Dr. Hardy of New York the membranous inflammation of diphtheria, commencing upon the fauces on the third day of scarlet fever, extended to the Schneiderian membrane, and thence along the left lachrymal sac to the eyelids, producing redness and swelling along the side of the nose and upon the cheek like that of erysipelas. A thick diphtheritic pellicle occurred upon the under surface of each eyelid on the left side, with great tumefaction of both lids, gangrene of the cornea, and destruction of the eye. The case soon ended fatally.

A pellicular exudation sometimes occurs in the larynx and trachea during the course of scarlet fever as a thin film, rendering the respiration noisy, but the development of a thick and firm pseudo-membrane, so as to imperil the life of the patient from the stenosis in the air-passages, has been much less frequent in my practice than it is in primary diphtheria and in diphtheria complicating measles or pertussis. The following were cases of this severe complication occurring in a recent epidemic in the New York Foundling Asylum. In these cases the respiration was noisy, but the obstruction to breathing was apparently due to infiltration and swelling around the aperture of the glottis, more than to the pseudo-membrane which the autopsies showed to be present:

Case 2.—A child aged three and a half years, who previously had symptoms of mild catarrhal croup, with moderate redness of the fauces, sickened with scarlet fever on Oct. 1, 1882, the rash being profuse and soon covering nearly the entire body. The axillary temperature was 103°, pulse 140; slight stridor in breathing and some cough; fauces very red, but free from membrane. Oct. 2d, restless, sleeping but little; has vomited four times. Oct. 3d, temp. 103.5°, pulse 120; fauces much swollen; still vomiting; rash abundant. 4 P. M., temp. 104.3°, pulse 128; tongue clean; some discharge from nares; urine not albuminous, but its quantity diminished. Oct. 4th, aspect that of very severe sickness; profuse discharge from nostrils; fauces of a deep-red color, and a pseudo-membrane over tonsils and uvula; tumefaction along the sides of the neck; temp. 104°, pulse 140; breathing moderately stridulous; urine is passed more freely than yesterday; evening temp. 105°. Oct. 6, croupy symptoms more marked; tonsils and uvula greatly swollen, so that the fauces are almost occluded; temp. 103.5°; breathing difficult, but apparently sufficient oxygen is received; profuse nasal discharge, and other symptoms as before. About 1.30 P. M. he was raised to take some milk, and suddenly became asphyxiated. His face was dusky, the eyes protruded, and he voided urine and feces. Dr. Swift, who attended the child, and to whom I am indebted for this history, immediately performed tracheotomy, which gave temporary relief by the expulsion of a considerable quantity of pseudo-membrane through the opening. On the following day the respiration again became obstructed at some point below the canula, so that it could not be removed; the features grew livid, and death occurred in convulsions twenty-six hours after the tracheotomy.

The autopsy was made by Dr. W. P. Northrup, curator of the asylum, who found the pharynx covered by a membrane which was traced to the posterior nares; larynx, trachea, and bronchial tubes as far as the third divisions covered with membrane; portions of the tracheal surface denuded, and the mucous membrane underneath of a bright-red color and smooth.

Case 3.—Katie, aged six and a third years, was returned to the asylum on Nov. 18th. Three days later (Nov. 21st) she had sore throat, reddened fauces, coated tongue, and a faint rash upon the neck, chest, and arms; eyes injected; temp. 102°. In the afternoon temp. 103°; eruption still faint. Nov. 22d, temp. 103.5°; an eruption on chest, abdomen, arms, and legs in patches. Evening temp. 104°; voice clear. Nov. 23d, temp. 103.5°; tongue red; fauces deeply reddened, but without any visible pseudo-membrane; the scarlatinous eruption has appeared over a considerable part of the surface. On the 24th a pseudo-membrane occurred over the tonsils and adjacent faucial surface; her respiration became labored, and death took place from dyspnœa at 11 P. M.

Autopsy.—Naso-pharynx covered by a thick fibro-purulent membrane. Larynx contains a well-marked pseudo-membrane, but not continuous. Trachea covered by a pseudo-membrane, continuous over most of its surface, but in places broken and flaky. Where it is detached the mucous membrane is seen underneath, dusky and deeply injected. At the root of the lungs the pseudo-membrane can be traced along the tubes about an inch in all directions. Nothing noteworthy in the other lesions.

In another case of scarlet fever, in which death occurred after an illness of three weeks and from gradually increasing dyspnœa, it is stated in the records of the autopsy that the larynx was free from a pseudo-membrane, but a thin film extended over a considerable part of the trachea.

Coryza frequently commences at or about the time of the pharyngitis. The inflammation of the Schneiderian membrane is continuous posteriorly with that of the fauces, and is announced by redness and swelling, inability to breathe freely through the nostrils, and an irritating ichorous discharge. Simple coryza in itself involves little danger, though it is an unpleasant complication, and in the nursing infant it may interfere with drawing the nipple. Diphtheritic coryza, on the other hand, which is frequently present when diphtheria complicates scarlet fever, involves danger. since it is apt to cause ulcerations, hemorrhages, and septic poisoning. When the local symptoms are unusually severe and the discharge abundant, it is probable that inflammation has in some cases extended to the antrum of Highmore.

Inflammation of the middle ear is another unpleasant and not infrequent complication. The statistics of different aurists collated by Dr. C. H. May, and presented in a paper on scarlatinous otitis read before the Pædiatric Section of the New York Academy of Medicine, March 4, 1889, show that about 5 per cent. of all aural affections result from scarlet fever, and in 10 per cent. of the cases of total deafness the loss of hearing is from this disease. It is due to extension of the catarrh from the pharynx along the Eustachian tube to the tympanum. In a considerable proportion of cases of otitis media this tube is occluded by the infiltration and swelling of its mucous membrane, so that the muco-pus escapes with difficulty or is retained. Hence severe earache, an increase of the febrile movement, and outward bulging of the membrana tympani occur. Sometimes headache or other cerebral symptoms arise, probably from the fact that the meningeal artery, which supplies the meninges, is connected by anastomosing branches with the tympanum. In one of the cases related above it will be recollected that the ulceration and abscess extended from the fauces to the middle ear, the entire Eustachian tube having disappeared in the ulcerative process.

Frequently, the otitis escapes detection, its symptoms being masked or obscured by the general disease, until the membrana tympani is perforated and otorrhœa begins; but by careful examination the nature of the complication can usually be ascertained before the ear is injured to this extent, for a patient too young to speak will often press with the fingers against the painful ear or lie with the ear pressed upon the pillow, evidently having an increase of suffering if placed in any other position. One old enough to speak and in proper mental condition makes known the earache as soon as it occurs. In most instances the scarlet fever has continued some days when the otitis begins. The otitis may begin insidiously, but in other instances it begins with a chill and a rise of temperature to 104° or 105°. The pain referred to the ear may be paroxysmal, and it is usually worse at night. It may radiate from the ear, following the branches of the fifth nerve. The patient experiences pain on pressure upon and around the tragus, and when the inflammation extends to the mastoid cells, pressure upon the mastoid process is also painful. The otitis may be unilateral, but in a large proportion of cases it is bilateral.

The mucous membrane of the tympanum, red and swollen from inflammation, secretes muco-pus abundantly, and this, pent up in the cavity, must obtain an exit before relief occurs. It is well if the secretion escape, though with difficulty, down the Eustachian tube. The destructive action of the pus upon the delicate structure of the ear is often such that within a few days irreparable harm is done and more or less deafness results. Relief can occur, if the Eustachian tube remain closed, only by perforation of the membrane and the discharge of the secretions into the external meatus. When this takes place the inflammation in the most favorable cases gradually abates, the aperture in the drum closes, and the integrity of the auditory apparatus is preserved. In severe cases the mastoid cells participating in the inflammation become filled with muco-pus and tender to the touch, and often the collateral œdema causes tumefaction and narrowing of the external ear, which subside with the discharge of pus from the tympanum.

Unfortunately, there is for many a more melancholy history—a more destructive inflammation, involving permanent impairment or total loss of hearing. This most frequently takes place in strumous or feeble children. All grades of inflammation and destructive action occur in different cases. The perforation in the drum-membrane may be large or the membrane may be completely destroyed, and the detached ossicles escape one by one into the external meatus, and in a few instances, fortunately rare, this occurs in both ears, porducing complete and permanent deafness. In my own practice this has never occurred, but I have met one or two adults who were totally deaf from this cause.

The mucous membrane which lines the bony wall of the middle ear has the function of the periosteum, and therefore when inflamed and subjected to pressure is liable to ulcerate. As in other parts of the skeleton under similar conditions, superficial caries or necrosis of the underlying bone is liable to occur. The carious or necrotic process may extend to the mastoid cells. An offensive otorrhœa, continuing for months or years, indicates the persistence of this pathological state of the tympanum, which is rendered so obstinate by the presence of dead bone. A moment's survey of the anatomical relations of the middle ear shows the danger to which these patients are liable. A thin bony septum, perforated with blood-vessels, and sometimes containing congenital apertures, separates the tympanum from the cranial cavity above. Posteriorly lie the mastoid cells, connected with the tympanum by one large and several small apertures. Anteriorly is the commencement of the Eustachian tube, and in close proximity to the tympanum lies the carotid canal, and at one point also the superior petrosal sinus. Virchow has shown how inflammation extending from the ear in otitis media sometimes produces such compression of the veins or sinuses by the swelling from the infiltration and exudation that the circulation is arrested, and the fibrin contained in the blood of these vessels is precipitated, forming thrombi, with the most disastrous effect upon the individual. Pus may also burrow in the interstices of the bone, causing great pain, or the pent-up secretions, having no outlet for escape, may in time undergo caseous degeneration, producing the conditions in which tuberculosis so often originates.

Death not infrequently occurs in chronic otitis media in another way. The otorrhœa, after months or years, suddenly ceases, the child complains of constant severe headache and is feverish, and the case ends in coma, preceded perhaps by convulsions. Meningitis has occurred, produced by extension of the inflammation through the thin bony septum which divides the tympanum from the cranial cavity, and at the autopsy hyperæmia of the meninges, fibrin, pus, perhaps softening of the brain and an abscess, are found in the portion of the encephalon adjacent to the tympanum. Therefore, otitis media, though it often ends favorably, is in many patients an obstinate, dangerous, and even fatal sequel of scarlet fever.

The complication known as *scarlatinous rheumatism* is regarded by some as a synovitis, but its symptoms, especially its shifting from joint to joint, seem to ally it to the rheumatic affections. In some epidemics it is common. It usually begins toward the close of the first week or in the second week, and its common seat is in the ankle, phalangeal, and wrist joints. It is attended by very little swelling in most patients, though the joints are tender and painful on pressure. It does not seem to retard convalescence materially, but it produces suffering and involves danger as regards the heart. It subsides in a few days with the ordinary treatment of acute rheumatism, and even without special treatment, the chief danger being that, as in idiopathic rheumatism, endocarditis may arise, with permanent crippling of the valves. The following was a case of valvular disease having this origin. It occurred in my practice.

CASE 4.—Freddy M——, aged four years, sickened with scarlet fever March 6, 1879. The usual vomiting occurred on the first day, and the temperature was 104°. The case progressed favorably till March 14th, when he complained of pain in both wrists, both ankles, and both knees. On March 17th the general condition was good, the urine contained no albumen and apparently few urates, but he still had pain in the joints of the upper and lower extremities and in the back; pulse 140, temperature 103°; breathes with a slight moan; urates in the urine, but no albumen. A distinct mitral regurgitant murmur is now heard for the first time. Under the use of salicylate of sodium the pain in the joints soon ceased, but the mitral murmur is permanent.

The following prescription is for a child of five years:

℞. Ol. gaultheriæ,	f℥j;	
Sodii salicylat.,	ʒiij;	
Syrupi,	f℥ij;	
Aquæ,	f℥iv.	Misce.

Sig.: Give one teaspoonfull every four hours in water.

Of the serous inflammations complicating scarlet fever, pericarditis has been, according to Rilliet and Barthez, most frequently observed. In this country it is probably more common than is usually supposed, but it is less frequently detected than pleuritis, the symptoms of which are more conspicuous.

The following case, which occurred in my practice, was an example of this complication:

CASE 5.—C——, girl, aged five years and ten months, sickened with severe scarlet fever on April 4th. Was delirious; pulse 158; had vomiting and constipation. April 10th, pulse varies from 124 to 153, no delirium; a considerable quantity of urates in the urine. April 11th, has to-day, for the first time, severe pain in the epigastrium, with tenderness and moderate distension. Otherwise symptoms favorable, but severe; pulse 140; respiration moderately accelerated and vesicular in every part of the chest. From this date the symptoms continued about the same till April 14th, when the dyspnœa became more marked and the action of the heart rapid and tumultuous. The epigastric pain, distension, and tenderness continued; the percussion sound was dull over the lower part of the chest; the dyspnœa became rapidly worse, although the pulse had considerable volume; and at 5 P. M. death occurred. At the autopsy about one ounce of turbid serum, with a soft deposit of fibrin, was found in the pericardium. Each pleural cavity contained from six to eight ounces of transparent serum, and both lungs were readily inflated, except a little of the posterior portions of both lower lobes; no fibrinous exudation over the lungs. The liver extended four inches below the margin of the ribs, and upon its convex surface in the epigastrium, corresponding with the seat of the pain, was a rough patch of fibrin about one and a half inches in diameter. The bronchial mucous membrane was moderately injected, as was also that of the colon, and the kidneys appeared hyperæmic.

Among the serous inflammations which complicate or follow scarlet fever, pleuritis is one of the most important. It usually begins in the desquamative stage, and is frequently suppurative, on account of the feeble state of the present when it commences. It has, in my practice, been tedious, as all empyemas are, and it does not differ in its clinical history from the idiopathic disease. I have met cases of scarlatinous empyema in which, from opposition of the family or for other reasons, thoracentesis was not performed and death occurred; others in which this operation effected a cure; and one, at least, in which the patient recovered by escape of pus through a bronchial tube and by expectoration. The pleuritis is seldom latent, or so masked by the symptoms of the general disease that it is liable to be overlooked. On the other hand, the cough, embarrassment of respiration, and pain referred to the affected side render diagnosis easy.

Dilatation of the heart is common in grave cases of scarlet fever, such cases as are properly termed malignant. It is indicated by a feeble and quick pulse. Acute infectious maladies, especially those of a malignant type and accompanied by a marked rise in temperature, are very liable to cause parenchymatous degenerations in organs, prominent among which is granulo-fatty degeneration of the muscular fibres of the heart. This weakens very much the contractile power of the heart. But early in malignant cases, probably before the muscular fibres are damaged, the contractile power of the heart is feeble from impaired innervation, the result of the general weakness. Hence this organ, when weakened by structural change and insufficiently stimulated through diminished innervation, may not fully empty itself during the systole, and consequently it becomes dilated. Dilatation of the heart and imperfect contraction of its auricular and ventricular walls facilitate the formation of clots in the cavities of the heart; and this appears to be the immediate cause of death in not a few instances. An ante-mortem clot occurring in any of the cavities of the heart necessarily seriously obstructs the circulation, unless it be of small size. Hence the dyspnœa, which may occur suddenly, and the change of pulse to one of marked feebleness and frequency. Large, firm white clots are most frequently found in the right cavities. They interlace with the chordæ tendineæ, lie even within the auriculo-ventricular opening, and send prolongations into the pulmonary artery and the cavæ. Associated with the white clots are dark, soft clots and fluid blood. The left cavities may be contracted and empty, or they may contain dark, soft clots or white ante-mortem clots. Clots in the left ventricle are sometimes prolonged into the aorta as far as the brachiocephalic branches, while those in the left auricle may extend to the pulmonary veins. If dilatation of the heart be so great that clots form in its cavities, speedy death is probable. Sometimes a patient passes through scarlet fever and appears in a fair way to recover, when he succumbs to some exhausting sequel distinct from the heart, and at the autopsy the heart is found dilated and containing whitish clots, which are probably ante-mortem, and which hastened death by obstructing the circulation. Under such circumstances this state of the heart is attributable in great measure to the complication which has weakened its contractile power.

The following was a case in point; it occurred in the New York Foundling Asylum:

CASE 6.—R. A——, aged three years, had scarlet fever, beginning March 23, 1882. The symptoms were favorable at first, but serious complications and sequelæ occurred, which were fatal. The record of April 18th reads: "Appears well nourished, but is anæmic; has otorrhœa; no œdema; skin desquamating; dulness on percussion over upper third of right side of chest, anteriorly and posteriorly; mucous râles and rude breathing over same area; fine râles posteriorly over lower part of left side of chest; pulse 160, respiration 68, temp. 101⅖°." April 20th, is feeble and takes nutriment with difficulty; tongue thickly coated; pulse 160, respiration 68, temp. 101⅖°. April 26th, condition about the same as at last record, but he is evidently weaker; the lips are ulcerated and fauces still swollen. May 2d, cannot speak distinctly; a brownish, foul-smelling secretion lodges on the spoon used in depressing the tongue; left side of face swollen. On the following night eight convulsions occurred, attended by orthopnœa and mucous râles in the chest from pulmonary œdema. Diarrhœa supervened and the patient died about midnight.

Autopsy.—Body moderately wasted and very white; several dark-blue spots on scalp and face from hemorrhages underneath. A careful examination showed the presence of broncho-pneumonia in each lung, with considerable infiltration of the walls of the bronchi and cylindrical dilatation of many of them; cavities of the heart dilated, so that this organ appears much enlarged, and its shape approaches the globular; its apex is rounded or obtuse; transverse diameter of the right ventricle, when its walls were open and drawn apart, was three and a fourth inches; that of the left ventricle, three and a quarter inches. Similar measurements of the heart of another child of about the same age, believed to be normal, were about one inch less in each direction. All the cavities contain white firm clots along with soft dark clots. Lesions observed in other organs were carefully noted, some of which were serious; but the immediate cause of death appeared to be imperfect contraction of the heart and the formation of clots in its cavities.

There can be little doubt that *nephritis* in its milder form is much more common than was formerly supposed. A few years since little attention was given by a large proportion of physicians to the state of the kidneys, and the urine was not examined till dropsy made its appearance, which only occurs in the more severe forms of nephritis and is a late symptom. It is now known that catarrh of the renal tubes frequently occurs in a mild form early in scarlet fever, without causing albuminuria, dropsy, or any notable symptom. It may produce a smoky color of the urine, and the appearance in it of granular epithelial cells, with an increase of mucus, but no albumen. With careful treatment and no exposure to cold the renal catarrh abates with the decline of the scarlet fever. It is scarcely severe enough to merit the name desquamative, tubal, or parenchymatous nephritis, though it is a mild form of the same pathological state. Steiner says, as the result of many careful examinations of cases, that hyperæmia of the kidneys was always present in those who died early in scarlet fever, and that in a certain proportion of these cases catarrh of the renal tubules was present in addition to the congestion. Even in some who died on the second or third day he found cloudiness of the epithelium in the renal tubes, although the urine had not indicated such a change. The opinion has even been expressed that catarrh of the renal tubes is as common in scarlet fever as that of the bronchial tubes in measles; that is, it is a uniform element in the disease; but this appears to be an exaggerated statement, for others have failed to find any evidence of renal catarrh in certain cases.

The nephritis which gives rise to symptoms, and therefore interests the practitioner, commonly begins in the declining period of scarlet fever or during the desquamative stage, and is in many instances plainly attributable to exposure to cold or to currents of air. It originates either during this period, or, if it have previously existed as a mild renal catarrh, it now becomes aggravated. Dropsy, which always attracts attention, does not occur till the nephritis has continued for some time.

Why nephritis, with the subsequent dropsy, so frequently occurs after scarlet fever is not fully understood. Rilliet and Barthez attribute it to disturbance of the function of the skin. The fact has long been observed that the kidneys become affected nearly if not quite as frequently after mild as severe cases. Indeed, the chief danger in mild cases, when the patients are but a short time in bed and are soon allowed to go about, is from the nephritis. Chilling the surface and checking cutaneous transpiration appear to be the immediate cause of this inflammation in a considerable proportion of cases. Therefore, severe attacks of scarlet fever with abundant rash and desquamation, which require the patient to be kept in bed the proper time and in a warm room two or three weeks, appear to be less frequently followed by this renal disease than are milder cases which are more carelessly treated.

The most thorough and minute microscopic examinations of the state of the kidneys in scarlet fever which have come to my notice were those of E. Klein, published in the *Lond. Path. Soc. Trans.* and illustrated by microscopic drawings. It appears from these examinations that the changes in the kidneys are complex, among which we recognize both those of parenchymatous or desquamative nephritis and interstitial nephritis; but we would infer that the interstitial nephritis is mild in degree and quite subordinate, or else confined to portions of the organ, from the fact that so many permanently and fully recover. The following is a résumé of Klein's examinations in twenty-three cases. We conclude from these microscopic researches that the anatomical changes of both parenchymatous and interstitial nephritis are commonly present in greater or less degree in cases of scarlet fever. If they are mild or confined to portions of the kidneys, no symptoms occur; but if they are sufficient in extent or degree to impair the function of these organs, then symptoms, as albuminuria, diminution of urine, etc., appear.

1. *Parenchymatous Nephritis, Proliferation of Nuclei, Hyaline Degeneration of Arterioles.—The Glomerulo-nephritis of Klebs.*—Klein found increase of nuclei (probably epithelial) in the glomeruli, and hyaline degeneration of the intima of minute arteries, especially marked in the afferent arterioles of the Malpighian bodies. The intima of these vessels was in places so swollen as to resemble cylindrical or spindle-shaped hyaline masses, and cause narrowing of the lumina of the vessels in which this degeneration occurred. Klein observed in some specimens so great hyaline degeneration of the capillaries of the Malpighian bodies that circulation through them was obstructed. In the more advanced or protracted cases this hyaline substance in the glomeruli began to assume a fibrous appearance. Bowman's capsule was considerably thickened. This hyaline degeneration of the Malpighian bodies Klein discovered in the earliest cases which fell under his observation.

Also in the earliest cases the multiplication or germination of the nuclei of the muscular coat of the arterioles was observed, with a corresponding increase in the thickness of the walls of these vessels. This change in the muscular element was found in the arterioles in different parts of the kidney, but it was most conspicuous in these vessels at their point of entrance into the Malpighian bodies; and it was distinctly noticed in other arterioles, both in the cortex and in the base of the pyramids.

In the glandular portion of the kidneys other anatomical alterations were observed, indicating parenchymatous nephritis. There were swelling of the epithelial lining of the convoluted tubes; multiplication of nuclei of epithelial cells, especially in ascending tubules, which lay close to the afferent arterioles of Malpighian corpuscles; granular matter, and even blood, in the cavity of Bowman's capsule and in the convoluted tubes; cloudy swelling and granular disintegration of epithelium in some parts of the convoluted tubes; detachment of epithelium from the membrane of larger ducts of the pyramids in some cases. These parenchymatous changes are already known to the profession through the observations and writings of Dickinson, Fenwick, Johnson, Simon, and others.

Klein, in commenting on the hyaline degeneration which he observed, states that Neelsen found the walls of the capillaries of the pia mater thickened, highly refractive, and of a lardaceous appearance in certain acute infectious maladies, as variola, typhoid fever, measles, and in one case scarlet fever.[1] Usually, only a small portion of the capillaries were thus affected, most frequently at the point of division into branchlets. In a few instances Neelsen noticed degeneration of arterioles extending a considerable distance, with fusion of the intima, media, and adventitia, and chemical examination showed that the substance produced by this degeneration had similar properties to elastic tissue. Although the examinations by Neelsen relate to the pia mater, two of his observations are especially interesting: first, that the hyaline change affects chiefly vessels near their point of branching; and secondly, that the hyaline substance is of the nature of elastic tissue, for in the kidney in scarlatinous nephritis the arterioles undergo the change in question chiefly near their point of branching into the capillaries of the glomerulus; and the intima being the part which undergoes the hyaline change, it is probable, in the opinion of Klein, that the same substance is produced by the degeneration in walls of the vessels of the kidney which Neelsen observed in the pia mater, and therefore that it is of the nature of elastic tissue.

This hyaline degeneration of the arterioles is also very marked in the spleen in scarlet fever; and in studying the minute anatomy of the intestines and spleen in typhoid fever Klein has found the same degeneration of the intima of the minute vessels. He believes that this hyaline change and the proliferation of muscle-nuclei which thus occur at an early period in scarlet fever in the renal vessels when the kidneys become affected are due to an irritating cause acting similarly to that in typhoid fever.

Klein calls attention to the interesting examinations of the scarlatinous kidney made by Klebs, who attributed the diminished urination and the uræmic poisoning in certain cases in which the kidneys do not exhibit any marked change to the naked eye to what he designates glomerulo-nephritis. Klebs says: "In the post-mortem examination the kidneys are found slightly or not at all enlarged, firm, ... the parenchyma very hyperæmic. Only the glomeruli appear, on close inspection, pale like small white dots. The urinary tubes are often not changed at all. Occasionally the convoluted tubes are slightly cloudy. The microscopic examination shows that there are neither interstitial changes nor proliferation of epithelium, the so-called renal catarrh generally supposed to be present in these conditions on account of the absence of other perceptible derangements: and there seems, therefore, leaving out the glomeruli, the congestion of the kidneys alone to remain to account for the symptoms during life." But that mere congestion is insufficient to produce the symptoms appears from the fact that it does not cause them under other circumstances. Klebs finds, "on microscopic examination of the glomerulus, the whole space of the capsule filled with small somewhat angular nuclei, imbedded in a finely granular mass. The vessels of the glomerulus are almost completely covered by nuclear masses."

Klein, commenting on these examinations by Klebs, states that in all early cases which he examined he observed great abundance of nuclei of the glomeruli, but a condition like that described and figured by Klebs[2] he has seen in only a few glomeruli; for a general state of these bodies, as described by this observer, and such an excessive proliferation of the nuclei that the blood-vessels are completely compressed, was not seen in one of the twenty-three cases. Klein therefore questions whether the diminished urination and retention of urea in scarlet fever, when the kidneys do not exhibit any conspicuous catarrhal or other change, is due, unless in exceptional instances, to compression of the vessels of the glomeruli by nuclear germination, but believes, rather, that the obstructed circulation, and consequent diminished urinary excretion, are largely due to the changed state of the arterioles.

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[1] *Archiv der Heilkunde*, 1876.

[2] *Handbuch der Pathol.*, p. 646, fig. 72.

Klein adds that perhaps undue contraction of the arterioles, through stimulation by the blood-irritant, may also be a factor in causing arrest of circulation in the Malpighian corpuscles. As regards cases that perished early, he found the parenchymatous change slight, so that a careful examination was required in order to detect cloudy swelling and granular degeneration.

2. *Interstitial Nephritis.*—A second set of changes Klein observed in cases that died about the ninth or tenth day. In such cases he found changes due to interstitial, in addition to those produced by parenchymatous, nephritis. Round cells, lymphoid cells, or whatever else they should be called, were seen in the connective tissue of the kidneys. In the kidneys of those that died at the end of the first week after the commencement of nephritis infiltration with round cells was observed in the connective tissue around the large vascular trunks. At a later stage this infiltration had extended into the bases of the pyramids and into the cortex. The gradual increase in extent and intensity of this infiltration was so decided in the cases which Klein observed that he has no hesitation in concluding that when interstitial nephritis occurs it begins about the end of the first week, in the manner already stated—to wit, as a slight infiltration of the tissues around the large vascular trunks, and gradually extends, so that portions of the cortex, and rarely portions of the base of the pyramids, are changed into firm, pale, round-cell tissue in which the original tubes of the cortex become lost.

The infiltration of the cortex with round cells, beginning at the roots of the interlobular vessels, spreads rapidly toward the capsule of the kidney, and laterally among the convoluted tubes around the Malpighian bodies. . . . . In the course of this process considerable parts of the peripheral cortex, occasionally of a cuneiform shape, with the base nearest the capsule of the kidney, become changed into whitish, firm, bloodless, cellular masses, in which Malpighian corpuscles and urinary tubes are only imperfectly recognized, being more or less degenerated. In some cases attended by this infiltration of the cortex Klein observed a more or less dense reticulation of fibres, especially around the interlobular arteries, containing in its meshes lymph-cells, chiefly uninuclear.

In a child of five years that died after a sickness of thirteen days Klein found evidence of intense interstitial inflammation, and also emboli, consisting of fibrin with a few cells, in the arteries, both in those of large size and in the arterioles, chiefly where they enter the Malpighian corpuscles. He states that in the specimens which he examined the more intense the degree of interstitial change, the greater was the enlargement of the kidneys, and the more distinct also were the evidences of parenchymatous nephritis in the urinary tubes, which either contained casts or were in process of destruction. By being crowded with inflammatory products, especially cells, the Malpighian corpuscles were obliterated, undergoing fibrous degeneration. A very curious fact observed was the deposit of lime in the urinary tubes, first of the cortex, and then also of the pyramids, at an early stage of scarlet fever, when the kidneys otherwise showed only slight change. Several observers, as Biermer, Coats, and Wagner, have each described a case of scarlet fever with interstitial nephritis, which they consider unusual; but Klein has apparently demonstrated, as we have seen, by a large number of microscopic examinations, that this form of nephritis is common after the ninth or tenth day.

Nephritis, in proportion to its extent and gravity, is accompanied by languor, febrile movement, thirst, loss of appetite and strength. At first the patient experiences but slight pain in the head or elsewhere, and the quantity of urine is not notably diminished; but as the disease continues urination becomes less frequent and the urine more scanty. Albuminuria occurs, while the urea is only partially excreted, and therefore it accumulates in the blood. If the nephritis be so severe or protracted that this principle accumulates to a certain extent, grave symptoms occur, as headache, vomiting, apathy, restlessness, and, more dangerous than all, eclampsia, which is not unusual in these cases. Microscopic examination of the urine shows the presence in this liquid of blood-corpuscles, granular epithelial cells, and hyaline or granular casts or both. The specific gravity of the urine is diminished. But a large quantity of albumen in the urine may render the specific gravity as high or higher than in health.

The altered state of the blood soon gives rise to transudation of serum, first observed in most cases as an anasarca occurring in the feet and ankles. The œdema, if not checked by treatment or through mildness of the disease, extends over the limbs, scrotum, and sometimes upon the trunk. It is well if the dropsy remain limited to the subcutaneous connective tissue, but, unfortunately, it is apt to occur, if the nephritis continue, in and around the internal organs, producing, mentioned in the order of frequency, pulmonary œdema, effusion into the pleural and peritoneal cavities, the pericardium, the encephalon, and lastly into the connective tissue of the larynx, causing that very fatal complication, œdema of the glottis. Although this is the common order in which dropsies occur, exceptions are not infrequent. Even the anasarca may not be the first to appear, although in the vast majority of cases it has the precedence. Thus, Rilliet relates the case of a boy of five years who twenty days after the occurrence of scarlet fever, and six hours after the appearance of bloody and albuminous urine, had double hydrothorax, rapidly developed. As long as the hydrothorax continued no anasarca was observed, but as it declined anasarca appeared. Legendre cites a case in which œdema of the lungs occurred without anasarca or other dropsy. Occasionally, the anasarca and internal dropsies take place nearly simultaneously. The nephritis and consequent serous effusions usually appear within three weeks after scarlet fever ends, but cases occur in which the effusions are first observed as late as the fourth and fifth weeks. The patient may be considered to possess immunity from this sequel if he have reached the close of the fifth week after the abatement of scarlet fever without its occurrence.

The dropsy is usually acute, but it may assume the chronic form, since the nephritis which causes it, happily curable in most instances, may, if neglected, become chronic. Whether the dropsy in itself involve danger depends in great part on its location. Anasarca and ascites may exist a long time with little suffering or danger, but a small amount of serum in certain other localities causes alarming symptoms and speedy death. Œdema of the lungs, hydro-pericardium, œdema of the glottis, and intracranial effusions are always dangerous, and the last two are sometimes fatal within twenty-four to forty-eight hours. Œdema of the lungs has been fatal within twelve hours from the appearance of the first symptoms of obstructed respiration.

Cerebral symptoms occurring during scarlatinous nephritis are probably sometimes due to the irritating effect of the retained urea on the nervous centre. In other cases the cause appears to be cerebral œdema or compression of the brain by effusion of serum within the ventricles and upon the surface of the brain. Headache, dull or severe, dilatation of the pupils or their oscillation in a uniform light, vomiting with little apparent nausea, are common symptoms of scarlatinous nephritis when it has continued a few days, and the excretion of urea is so diminished that this substance begins to exert its poisonous effect on the system. Such symptoms are frequently followed by somnolence threatening coma or by eclampsia, unless the patients are promptly and properly treated. In some patients that die of scarlatinous nephritis, death occurring in convulsions or coma, no appreciable lesions are observed within the cranium, unless more or less congestion, the fatal ending being attributable to the uræmia. In other instances we find an effusion of serum within the ventricles or upon the surface of the brain. Although the symptoms in scarlatinous nephritis and uræmia may appear very unfavorable, the prognosis is usually good under prompt and appropriate treatment. Thus severe convulsions and a degree of somnolence that bordered on coma may abate, and convalescence be fully established within a few days. Rilliet and Barthez announce ten recoveries in thirteen patients affected with convulsions due to this renal affection.

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Anatomical Characters.—Scarlet fever being, as we have seen, a constitutional febrile disease of an ataxic nature, and accompanied by certain inflammations, necessarily affects the composition of the blood; but since this disease varies so greatly in type or severity, the state and appearance of this liquid also vary. At the autopsies of the more malignant cases we find the blood dark and fluid, with small, soft, and dark clots in the heart and large vessels. In other cases the clots are large, firm, and solid, as described in a preceding page. In malignant cases that end fatally Rilliet and Barthez state that both the large and small vessels of the cerebral meninges and the brain are found hyperæmic, but in a variable degree. In those who die in coma, preceded by delirium or convulsions, during the eruptive stage the intracranial congestion is usually marked, with perhaps some transudation of serum, but without inflammatory lesions. The fibrin in scarlet fever remains in about normal proportion, except as it is increased by inflammatory complications. Andral found an increase in the proportion of blood-corpuscles from 127 to 136 parts in 1000.

The respiratory apparatus, except the Schneiderian membrane, is usually normal when no complications exist. Samuel Fenwick[1] made post-mortem examinations in sixteen cases of scarlet fever, and concludes from them that inflammation of the mucous membrane of the stomach and intestines occurs like that of the skin, followed by desquamation of the epithelial cells, like that of the epidermis. I have had the opportunity of examining the stomach and intestines of those who died of scarlet fever in the eruptive stage, and have not found any unusual hyperæmia of the gastro-intestinal surface, except when gastro-intestinal inflammation, usually indicated by diarrhœa, had occurred as a complication.

In some cases the abdominal organs exhibit changes which suggest a resemblance to typhoid fever. The spleen is enlarged and somewhat softened, and Peyer's patches and the solitary glands are thickened and prominent, but less in degree than in typhoid fever. The mesenteric glands also are in a state of hyperplasia. In other patients these parts appear normal.

Klein made microscopic examination of the liver in eight cases, and states that he found granular opaque swelling of liver-cells, and changes in the internal and middle coats of certain arteries similar to those observed in the kidneys which have been described above. He also found evidences of interstitial inflammation, as an increase of round cells and connective tissue in the liver. He remarks also that he observed hyaline degeneration of the intima of arteries in the spleen. Rilliet and Barthez state that swelling and softening of the spleen are exceptional in scarlet fever, but are sufficiently common to merit attention. In post-mortem examinations which I have witnessed nothing noteworthy has appeared to the naked eye in the state of the liver, nor ordinarily in that of the spleen.

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[1] *London Lancet*, July 23, 1864.

The efflorescence, though one of the anatomical characters, has perhaps been sufficiently described in the foregoing pages. It begins over the neck, chest, and groins as numerous reddish points not larger than a pin's head, closely crowded together, but with skin of normal color between. It is estimated that the aggregate efflorescence and aggregate normal skin over a given area are about equal. If the cutaneous circulation be active and the rise of temperature considerable, these spots extend and coalesce, producing an efflorescence like erythema or like the hue of a boiled lobster, to which it has been likened. The efflorescence, less upon the face than upon the trunk, contrasts in this respect with that of measles, in which the rash is full in the face, often causing some swelling of the features. It is also less upon the palmar and plantar surfaces than elsewhere. It scarcely causes any perceptible elevation of the skin, but in certain localities, as upon the backs of the hands and upon the forearms, it communicates the sensation of slight roughness. The seat of the efflorescence is mainly in the superficial layers of the skin, but it is said that it sometimes has occurred upon a cicatrix, as that from a burn. In the robust and in favorable cases in which the circulation is active the rash has a scarlet hue, and when the cutaneous capillaries are emptied and the skin rendered pale by pressure with the fingers, the circulation immediately returns when the pressure is removed. In malignant cases the color is not scarlet, but dusky red, and so sluggish is the capillary circulation that the skin when pressed upon recovers the blood very slowly. In grave cases also extravasation of blood in minute points or transudation of its coloring matter sometimes occurs in portions of the surface when, of course, decolorization is not fully produced by pressure. In cases ending fatally, during the eruptive stage the efflorescence may entirely disappear in the cadaver, or it remains upon parts of the surface, especially depending portions. Desquamation is attributable to the exaggerated proliferation of the epidermis and the loosening of its attachment by the inflammation.

DIAGNOSIS.—In the commencement of scarlet fever, prior to the eruption, no symptoms or appearances exist which enable us to make a positive diagnosis. Positive statement in reference to the nature of the attack should be deferred, for the credit of the physician. Still, if a child with no appreciable local disease sufficient to cause the symptoms a few days after exposure to scarlet fever, or during an epidemic of this malady, be suddenly seized with fever, the pulse rising to 110, 120, or more, and the temperature to 102°, 103°, or 105°, scarlatina should be suspected. The diagnosis is rendered more certain at this early stage if vomiting occur, and especially if the fauces be red, for hyperæmia of the fauces, due to commencing pharyngitis, is one of the earliest and most constant of the local manifestations of scarlatina.

When the eruption has appeared the nature of the malady is in most instances apparent. The punctate character of the eruption before it becomes confluent, its occurrence within twenty-four hours after the fever begins over almost the entire surface, but its absence or scantiness upon the face, and especially around the mouth, serve to distinguish it from other diseases.

Scarlet fever and measles were long considered identical by the profession, and, though the ordinary forms of these maladies can be readily distinguished from each other, cases occur in which the differential diagnosis is attended by some difficulty. But there are differences in the symptoms and course of the two diseases which aid in discriminating one from the other. Measles begins with marked catarrhal symptoms, as if from a severe cold. Mild conjunctivitis, causing weak and watery eyes, coryza, and mild laryngobronchitis, with accompanying cough, precede the eruption three or four days and continue during the eruptive stage. The fever during the first or initial stage of measles is remittent, the evening temperature being two or three degrees higher than that in the morning. Contrast this with the invasion of scarlet fever, in which the only catarrh is that of the buccal and faucial surfaces, and there is consequently little or no cough, and the rise in temperature, ordinarily high in the beginning, is nearly uniform in the different hours of the day. The scarlatinous eruption appears, as we have seen, within twelve to twenty-four hours about the neck and upper part of the chest, and spreads over the body in a shorter time than that of measles, which appears on the third day. The rash of measles begins to fade at the close of the third or in the fourth day after its appearance, that of scarlet fever not till from the sixth to the eighth day. In nearly all cases of measles, even when the rash is confluent upon the face and a considerable part of the trunk in consequence of the high fever and active cutaneous circulation, we observe the characteristic rubeolar eruption upon certain parts of the surface, as the extremities; which, in connection with the history, renders diagnosis certain.

Erythema resembles the scarlatinous eruption, but its duration is commonly shorter. It is limited to a part of the surface, and it is accompanied by much less fever. The temperature in erythema does not usually rise above 100°, unless for a few hours, whereas in scarlet fever it continues several days considerably above 100°. The scarlatinous efflorescence has also a brighter red or more scarlet hue than that of erythema, except in the more malignant cases, in which the severity of the symptoms renders the diagnosis clear. But an important aid in differentiating the one from the other of these diseases is the fact that in erythema there is, with few exceptions, no faucial inflammation, and in the few instances in which it is present it is slight and transient, fading within a day or two.

Scarlet fever is readily diagnosticated from diphtheria, although the affinity is close between these two maladies. The early appearance of the pseudo-membrane upon the fauces in diphtheria, its absence in scarlet fever, and the absence of any appearance resembling it until the fever has continued some days, and the characteristic efflorescence upon the skin in scarlet fever, render diagnosis easy. If scarlet fever have continued some days when first seen by the physician, the diphtheritic pseudo-membrane may be present as a complication, or the fauces may present an appearance like diphtheria from ulceration or sloughing and the presence of foul and offensive secretions, which produce a dark-grayish and fetid mass over the faucial surface. Under such circumstances the character of the disease is ascertained by the history of the case, and especially by the occurrence of the scarlatinous eruption. An erythema transient and limited to a part of the surface sometimes appears in the commencement of diphtheria, and at a later period, as a result of the toxæmia upon the extremities. Roseoloid points and patches often occur upon the extremities. Both kinds of rash can be readily diagnosticated from that of scarlet fever, for the erythema, as has been stated, is transient and partial, and does not exhibit minute points of deeper injection, while the toxæmic rash differs in form and aspect from that of scarlet fever, and appears at a stage when the scarlatinous efflorescence has faded or begun to fade.

The efflorescence of rötheln sometimes closely resembles that of scarlet fever, though it is usually more like that of measles; but it is ordinarily accompanied by symptoms which are much milder than those of scarlet fever, and it begins to abate as early as the third, and disappears on the fourth, day. The eyes have a suffused appearance, the temperature may reach 102° or 103°, and the efflorescence may be as general over the body as that of scarlet fever, but there is not the aspect of serious indisposition, and the speedy abatement of the symptoms shows that the disease is not scarlet fever.

Prognosis.—The prognosis depends on the form of scarlet fever, whether mild or severe, the strength of the patient, and the presence or absence of complications or sequelæ. The type of the disease is sometimes so mild throughout an epidemic or during a series of years that death seldom occurs, whatever the mode of treatment; but afterward the type changes, and the percentage of deaths increases and remains high till another amelioration in the type occurs.

Sydenham in the middle of the seventeenth century stated that scarlet fever, as he saw it in London, was so mild that it scarcely deserved the name of disease: "Vix nomen morbi merebatur." Morton some years later, and Huxham in the following century, had abundant reason to regret the change of type, and now throughout Great Britain scarlet fever is one of the most fatal and most dreaded of the diseases of childhood. In Dublin during the present century, prior to 1834, scarlet fever was uniformly mild, so that on one occasion of eighty patients in an institution all recovered. In 1834 the type of the disease totally changed and epidemics of unusual virulence occurred. The type frequently changes from mild to severe or severe to mild, not only in consecutive years, but in consecutive months. A few years since a distinguished physician of New York treated about fifty cases of scarlet fever in one of the institutions without a single death, but a few months later the type of the malady changed, and his own son was among those who perished from it. The prevailing type of the disease should therefore be considered in giving the prognosis when in the commencement of a case we are asked the probability as regards the termination.

Extensive statistics, including those collected by Murchison from various sources, show that in different epidemics the mortality may vary as much as from 3 per cent. (Eulenberg of Coblentz) to 19.3 per cent. (cases seen by myself in New York City in 1881–82, many of which were complicated by diphtheria), or even to 34 per cent. (epidemic in the Palatinate in 1868–69). The hospital statistics of Rilliet and Barthez gave 46 deaths in 87 cases, or about 53 per cent.

Observations have thus far failed to establish any connection in the atmospheric conditions of temperature or moisture and the type of scarlet fever. Grave as well as mild epidemics have occurred in all climates and seasons.

The mortality is nearly equal in the two sexes, but age has a marked influence on the percentage of deaths. The period of the greatest mortality, and also of the greatest frequency, of scarlet fever is between the ages of one and six years. The following are statistics bearing on the relation of the age to the percentage of deaths:

		Under 1 year.	From the close of 1st till close of 5th year.	From the 5th to the 12th year.
Fleishman:	Cases .	8	204	260
	Deaths .	6	88	51

			1st to close of 6th year.	6th to 12th year.	From the 12th to 20th year.
Kraus:	Cases	13	113	106	40
	Deaths	4	29	10	2

				7th to 16th year.
Voit:	Cases .	5	166	109
	Deaths .	1	24	10

		Under 1 year.	From 1st to close of 5th year.	Over 5 years.
Röset:	Cases	43	156	88
	Deaths	16	31	3

		Under 5 years.	5th to 10th year.	10th to 15th year.	Over 15 years.
Russinger:	Cases	101	126	47	27
	Deaths	21	20	3	0

These statistics, which I believe correspond with the observations of others, show that although few cases occur in the first year, the percentage of deaths is large, and that a majority of the total deaths from this malady occur under the age of six years. After the sixth year the greater the age the less the proportionate number of deaths.

Scarlet fever is liable to so many complications and sequelæ that a physician should not predict a certain favorable termination in the beginning, however mild and regular the symptoms may be. But a favorable result may be expected if the attack be mild, the efflorescence appear at the proper time and extend over the entire surface, the angina be moderate and accompanied by little or no cellulitis or adenitis, with pulse under 140, temperature not above 103°, and no marked nervous symptoms.

Whether the complications or sequelæ be dangerous depends upon their character. Rheumatism has never in my practice been dangerous, nor has it materially retarded convalescence, except when it affected the heart, causing pericarditis or endocarditis, when it involves great danger. Nephritis, if it be moderate, attended by little albuminuria and serous effusion and by the occurrence of few renal casts in the urine, commonly ends favorably under judicious treatment, as we have already stated; but severe nephritis, with abundant albuminuria and casts and serous effusions, soon gives rise to alarming symptoms, and is the cause of death in a considerable number of instances. A similar remark is applicable to the angina, which occurs in all grades of severity. If it be attended by much cellulitis, with considerable ulceration or necrosis, the state is one of danger in consequence of the difficulty in administering sufficient nutriment, as well as from the diminished assimilation and the loss of strength due to the prolonged inflammatory fever, the septic poisoning, and the occasional hemorrhages. Complication by pharyngeal or nasal diphtheria, now so common where diphtheria is endemic, also greatly increases the danger.

Many cases, even when their course is normal and without complications, involve danger, and some are necessarily fatal, from the direct effect of scarlatinous blood-poisoning. Such are grave or malignant forms of the disease which the experienced eye recognizes at a glance. Death often occurs rapidly from the toxæmia. Such cases are characterized by high temperature (105° or 106°), rapid pulse, dusky-red hue of the surface from languid capillary circulation, pungent heat, frequent vomiting, diarrhœal stools, a dry-brown tongue, and marked nervous symptoms, such as delirium, great restlessness, or stupor. Not a few in this form of scarlet fever take eclampsia, which is likely to be severe and repeated, and to end in fatal coma.

Other inflammatory complications and sequelæ, which have been described in the preceding pages, retard convalescence and jeopardize the life of the patient, such as empyema, endocarditis, pericarditis, and pneumonia. Otitis media is seldom immediately dangerous, although it may be painful and involve serious consequences, even a fatal meningitis, as has been stated above, after months or years of otorrhœa. Anomalous cases are believed to be, as a rule, more dangerous than such as are attended by an early and full efflorescence and have the usual symptoms.

Treatment.—*Prophylaxis.*—Since the discovery by Jenner of the prophylactic power of vaccination as regards smallpox, the attention of the profession has been frequently directed to the prevention of scarlet fever. Belladonna has been employed for this purpose by a class of practitioners who believe in the theory that an agent which produces symptoms similar to those of a disease is antagonistic to that disease, and therefore tends to prevent it, or, if it be present, to render it milder; and since this herb causes an efflorescence upon the skin and redness of the fauces, it was selected as the proper preventive and remedial agent for scarlet fever. Its, use, however, for this purpose has been fruitless, and it is now nearly or quite discarded.

It is now known, from a considerable number of observations, that scarlet fever occasionally occurs in the domestic animals during epidemics of the disease in children. It is stated that Spinola observed it in the horse; that Heim saw a dog that occupied the same bed with a scarlatinous patient sicken with fever, which was followed by desquamation; that Letheby saw scarlatina in swine, and Kraus in young cattle. Prominent veterinary surgeons, as Williams of Great Britain, admit the occurrence of scarlatina in animals, and the hope has arisen that since smallpox is modified in cattle so as to afford us the vaccine virus, perhaps scarlet fever may also be modified by passing through one of the lower animals, so that a milder and less fatal form of the disease might be produced in man by inoculation from the animal. This theory, though it deserves investigation, is far from being established. It has not yet, so far as I am aware, been shown that scarlet fever is milder in any animal than in man, nor, if we admit that it is modified in the animal, is it certain that the disease could be returned to man in the modified form. In the *New York Medical Record* for March 24, 1883, some experiments are detailed by S. W. Stricker of Orange, New Jersey. He cites experiments of Caze and Feltz, who injected scarlatinal blood under the skin of 66 rabbits, and of these 62 died within eighteen hours to fourteen days, which indicated a highly poisonous state of the blood employed, either septic or scarlatinous, and certainly no mitigation of the virulence of the scarlet fever. Strickler obtained from Williams of Edinburgh nasal mucus from a horse supposed to have scarlatina, and with it inoculated twelve children, all of whom had sores at the point of inoculation, with redness of the skin around the sores, and in some instances swelling of the adjacent lymphatic glands. It is stated that the children thus inoculated did not contract scarlet fever subsequently when they were exposed to it. Obviously, there is a serious objection to such experiments upon children, so that they may not be repeated. Children thus experimented on might, like the rabbits, die. The experiments involve too great a risk as regards the health and safety of the children experimented on. Under the circumstances the experimenter who propagates so dangerous a disease by inoculation renders himself liable, it seems to me, to criminal proceedings in the courts.

It is a matter of great interest and importance, and one not yet elucidated, whether or to what extent disinfectant and antiseptic remedies, administered internally, prevent the occurrence of the infectious maladies in those who have been exposed and aid in curing those who are sick with them. Sodium sulphocarbolate, from which, by decomposition in the system, carbolic acid is supposed to be set free, has been used for this purpose. It is administered to adults in doses of ten to thirty grains, and to children in doses proportionate to their age. Declat has prepared a syrup of phenic (carbolic) acid as a preventive and curative agent in the infectious diseases. It is now employed by several of the New York physicians, but thus far the statistics of its use are not sufficient to determine its efficacy. It is a question whether the so-called antiseptics can, on account of their toxic properties, be used with safety in doses sufficiently large to be antidotal to the specific principle of scarlet fever.

In the present state of our knowledge the most reliable and certain prophylaxis is the isolation of patient and nurses and the thorough and judicious employment of disinfectants upon their persons and in the apartments. All furniture and articles not absolutely required should be removed from the sick-room, and no one should be allowed to enter it except the medical attendant and nurses. Constant ventilation should be insisted on by lowering the upper and raising the lower sash of the window two or three inches in mild weather. Even in stormy weather sufficient ventilation can be obtained in this way without exposing the patient to currents of air, which should be avoided.

The New York Board of Health enforces the following regulations to prevent the spread of scarlet fever as well as other acute infectious maladies:

"*Care of Patients.*—The patient should be placed in a separate room, and no person except the physician, nurse, or mother allowed to enter the room or to touch the bedding or clothing used in the sick-room until they have been thoroughly disinfected.

"*Infected Articles.*—All clothing, bedding, or other articles not absolutely necessary for the use of the patient should be removed from the sick-room. Articles used about the patients, such as sheets, pillow-cases, blankets, or clothes, must not be removed from the sick-room until they have been disinfected by placing them in a tub with the following disinfecting fluid: eight ounces of sulphate of zinc, one ounce of carbolic acid, three gallons of water. They should be soaked in this fluid for at least an hour, and then placed in boiling water for washing.

"A piece of muslin one foot square should be dipped in the same solution and suspended in the sick-room constantly, and the same should be done in the hallway adjoining the sick-room.

"All vessels used for receiving the discharges of patients should have some of the same disinfecting fluid constantly therein, and immediately after being used by the patient should be emptied and cleansed with boiling water. Water-closets and privies should also be disinfected daily with the same fluid or a solution of chloride of iron, one pound to a gallon of water, adding one or two ounces of carbolic acid.

"All straw beds should be burned.

"It is advised not to use handkerchiefs about the patient, but rather soft rags, for cleansing the nostrils and mouth, which should be immediately thereafter burned.

"The ceilings and side-walls of a sick-room after removal of the patient should be thoroughly cleaned and lime-washed, and the woodwork and floor thoroughly scrubbed with soap and water."

By such measures of prevention there can be no doubt that the number of cases of scarlet fever has been reduced.

But do the health boards accomplish all that they are able to do in suppressing scarlet fever as well as diphtheria? The New York Health Board excludes children from the schools who live in the houses where these diseases are occurring, gives directions in reference to the care of the patient and the disposition of infected articles, and promises to disinfect the sick-room when word is sent to the board. But these measures are inadequate or are only partially successful in preventing these diseases. To my knowledge, many families in New York never send word that they are ready for the disinfection of the apartments, and many families in the tenement-houses move away as soon as possible. The vacated rooms are re-rented to families who have no knowledge of the previous sickness, and are surprised when their children immediately after are taken sick. It would be better if the health board in every instance disinfected the infected apartments after the termination of the sickness, whether the family are willing or not. Moreover, the reader is referred to our remarks on the prevention of diphtheria for evidence of the inadequacy of the sulphur fumigation. In my opinion, fumigation both by burning sulphur and by chlorine, as employed by Prof. Doremus in Bellevue Hospital, should be used before the apartments are reopened for occupancy, and the ceiling, walls, and floor should be washed with a corrosive-sublimate solution or other efficient antiseptic lotion.

But the suppression of scarlet fever cannot be effected without the co-operation of the attending physician. He can accomplish more than the health board in the way of prophylaxis. Twenty-one years ago the late Dr. William Budd of England recommended prophylactic measures, and the following is his testimony in regard to the result: "The success of this method in my own hands has been very remarkable. For a period of nearly twenty years, during which I have employed it in a very wide field, I have never known the disease to spread beyond the sick-room in a single instance, and in very few instances within it. Time after time I have treated this fever in houses crowded from attic to basement with children and others, who have nevertheless escaped infection. The two elements in the method are separation on the one hand and disinfection on the other."[1]

In my opinion it is quite possible to realize the experience of Dr. Budd if proper prophylactic measures be employed from the beginning of the sickness. The attending physician at his first visit and at each subsequent visit should consider it an imperative duty to direct the employment of adequate preventive measures. Health boards give directions that objects not required to promote the comfort of the patient should be removed from the sick-room, and no one be allowed to enter it except the physician, nurse, and mother. The floor and walls of the apartment should be bare, but I would go farther than the health board, and insist that no reading matter, especially books and primers, be allowed in the room, or if allowed they should subsequently be burnt, since, as we have seen, the specific poison obtaining lodgment between the leaves is not readily reached by disinfectants, and may communicate the disease months afterward. I recommend for disinfection of the room at my first visit, and also for cases of diphtheria, the following prescription:

℞. Acidi carbolici,
Ol. eucalypti, *āā.* ℥j;
Spts. terebinth., ℥vj. Misce.

Two tablespoonfuls are added to one quart of water in a tin wash-basin or similar vessel with broad surface, and maintained in a state of constant simmering over a gas- or oil-stove during the entire sickness. The odor of this vapor is agreeable rather than unpleasant, and it appears to disinfect to a considerable extent the breath and exhalations from the body of the patient. At the same time, I order inunction of the entire surface every third hour with the following:

℞. Acidi carbolici,
Ol. eucalypti, *āā.* ℥j;
Ol. olivæ, ℥vij.

Dr. Jamieson recommends disinfection of the fauces by the frequent application of a saturated solution of boracic acid in glycerin. This or some other non-irritating solution should be often applied, not only to the fauces, but also in the anginose cases to the nostrils. I have recommended the application of corrosive-sublimate solution, two grains to the pint, applied to the fauces by a camel-hair pencil or by cotton wadding wound around a slender stick, in the same manner in which Dr. Oatman and others employ it in diphtheria.

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[1] *British Medical Journal*, January 9, 1869.

The cautious physician in attending a case of scarlet fever will always bear in mind the possibility that his person or clothing may become infected, and be the vehicle through which the poison may be communicated to others. In examining the fauces of a patient he should stand a little to one side, so that no muco-pus, if the patient cough, be received on his clothing; nor will he go directly from a scarlatinous patient to a child with another sickness, or to a midwifery case, without first washing his hands, hair, and face in a corrosive-sublimate solution, and changing his outer apparel; or if he visit a child without such precautionary measures, he will not approach any nearer than is sufficient to enable him to determine its ailment and condition.

Hygienic Treatment.—The room occupied by a scarlatinous patient should be commodious and sufficiently ventilated. Its temperature should be uniform at about 70° during the course of the fever. When the fever begins to abate and desquamation commences, a temperature of 72° to 75° is preferable, so that there is less danger that the surface may be chilled during unguarded moments, as at night, when the body may be accidentally uncovered, since sudden cooling of the surface at this time may cause nephritis or some other dangerous inflammation. Henoch does not believe in the theory that the nephritis is commonly produced by catching cold, but many observations show that those who are carefully protected from vicissitudes of temperature, who remain during convalescence in a warm room, and are protected by abundant clothing, more frequently escape this complication than such as are under no restraint of this kind and are carelessly exposed in times of changeable weather. Nevertheless, it is true that a certain proportion suffer from nephritis however judicious the after-treatment may be. The best hygienic management does not always prevent its occurrence. The patient should not, therefore, leave the house until four weeks after the beginning of the fever, and in inclement weather not till a longer time has elapsed. So long as desquamation is going on and the skin has not regained its normal function, the patient should remain indoor, and when finally he is allowed to leave the house he should be warmly clothed.

Therapeutic Treatment.—In order to treat scarlet fever successfully, it is necessary to bear in mind that it is a self-limited disease, running a certain time and through certain stages, and that it is not abbreviated by any known treatment. Therapeutic measures can only moderate its symptoms and render it milder. The severity of the disease is indicated by its symptoms, and the symptoms are to a certain extent under our control.

Mild Cases.—A patient with a temperature under 103° and with only a moderate angina does not require active treatment, but, however light the disease, he should always be in bed and in a room of uniform temperature, as stated above. Instances have come to my notice in the poor families of New York in which scarlet fever was not diagnosticated, and the patients were allowed to go about the house, and even in the open air, in the eruptive stage, till some severe complication or an aggravation of the type created alarm and medical advice was sought, when it appeared that a grave and dangerous condition had, through carelessness and ignorance, resulted from a mild and favorable form of the malady. The physician, when summoned to a case however mild, should never fail to take the temperature, note the pulse, inspect the fauces, and inquire in reference to the fecal and urinary evacuations, that he may detect early any unfavorable changes which may occur.

Since in all cases angina and more or less blood-deterioration are present, the following prescription will be found useful in mild as well as severe scarlet fever:

℞. Potass. chlorat., ʒss;
Tr. ferri chloridi, f℥ij;
Syrupi, f℥iv. Misce.

Sig.: Dose, one teaspoonful every hour to two hours to a child of three years.

Small doses of this medicine frequently administered act beneficially on the surface of the throat and tend to prevent the anæmia which is so common after scarlet fever. If the medicine be given gradually, diluted with only a moderate amount of water, the effect is better on the inflamed fauces. Potassium chlorate is known to be an irritant to the kidneys in large doses, causing intense hyperæmia of these organs, with bloody urine or suppression of urine. The melancholy fate of Fountaine, who died from the effects of one ounce of this medicine, is known to the profession. I have seen a similar instance in a child. But doses of half a grain to two grains, according to the age, can be administered with safety to children, so that twenty to thirty grains are taken in twenty-four hours. A quantity much exceeding this amount involves risk.

℞. Quiniæ sulphat., gr. xvj;
Syr. pruni virginiani,
Syr. yerbæ santæ comp., āā. ℥j. Misce.

Sig.: One teaspoonful every fourth hour to a child of three to five years, the potassium chlorate and iron mixture being administered twice between.

The treatment of scarlatina by antiseptic remedies will be considered hereafter.

The itching and dryness of the surface, which increase the discomfort of the patient in mild as well as severe scarlatina, are relieved by the ointment mentioned in treating of prophylaxis. The linen should be changed every day and the bed thoroughly aired.

Ordinary Cases and Cases of Severe Type.—A safe temperature in scarlet fever may be considered at or below 103°. If it rise above this, measures designed to abstract heat are very important—more important even in many cases than the medicinal agents which are commonly used to combat this disease. Since a high temperature retards assimilation, promotes deleterious tissue-change, and causes rapid emaciation and loss of strength, measures designed to reduce it are urgently needed. "The production of heat depends chiefly on oxidation of the constituents of the body" (Billroth). Therefore, fever indicates an increase of the oxidation and a molecular disintegration above the healthy standard. Hence the augmentation of urea in the urine and the progressive emaciation and loss of weight which characterize the febrile state. Fever also diminishes the secretions by which food is digested and destroys the appetite, so that repair of the waste is insufficient. Moreover, a high temperature continuing for a time tends to produce degenerative changes, albuminous and fatty, in the tissues, the more rapidly the higher the temperature, so that the functions of organs are seriously impaired. Among the most dangerous of the tissue-changes is granulo-fatty degeneration of the muscular fibres of the heart. In dogs and rabbits that have perished from a high temperature artificially produced by experimenters granular clouding of the elementary tissues has been found after death.[1] A high temperature, therefore, in itself involves danger, and if it occur in an ataxic disease like scarlet fever, and be protracted, it greatly diminishes the chances of a favorable issue.

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[1] See experiments by Mr. J. W. Legg, *Lond. Path. Soc. Trans.*, vol. xxiv., and others.

The temperature can be reduced without shock or injury to the child by the judicious use of cold water externally. The cold-water treatment is not necessary if the temperature be under 103°, though useful if judiciously employed by sponging when the temperature is at 102° or 103°; but if it rise above 103° it is required, and the more urgently the higher the temperature. The external use of cold water as an antipyretic in the febrile diseases is now almost universally recommended by physicians, but it still meets with opposition on the part of families, especially in the treatment of the exanthematic fevers, and the directions for its employment are therefore not likely to be fully carried out during the absence of the medical attendant. The old theory that the fevers require warmth and sweating has such a firm hold on the popular mind that some years longer will be required for its removal.

The modes of applying cold water recommended by cautious and experienced physicians are various. Von Ziemssen recommended that the patient be immersed in water at a temperature of 90°, and cool water be gradually added till the temperature fall to 77°. In a few minutes the patient is returned to his bed, his surface dried, and he is covered by the proper bedclothes, when his temperature will probably be found reduced two or two and a half degrees. If the patient complain of chilliness or his pulse be feeble, he should be immediately removed from the bath and stimulants administered, either whiskey or brandy, for if the extremities remain cool and the capillary circulation sluggish, the effect may be injurious, since some internal inflammation may arise to complicate the fever. Under such circumstances increased alcoholic stimulation is required.

The cold pack is also effectual for reducing the temperature. The patient is placed upon a mattress protected by oil cloth, and is covered by a sheet wrung out of water at a temperature of 70°. This is covered by one or two blankets. In half an hour he is returned to bed, and will be found to have a temperature two or three degrees less than that before the bath. Another method is to apply the sheet wrung out of water at 90°, and then reduce the temperature by adding water at a lower degree from a sprinkler. In most cases, however, I prefer to reduce the temperature by the constant application to the head of an India-rubber bag containing ice. The bag should be about one-third filled, so that it should fit over the head like a cap. At the same time, as a potent means of abstracting heat, at least when the temperature is at or above 104°, a similar application should be made by an elongated rubber bag lying over the neck and extending from ear to ear. Cold applied over the great vessels of the neck promptly abstracts heat from the blood, while it diminishes the pharyngitis, adenitis, and cellulitis; which is an important gain. At the same time, it is proper to sponge frequently the hands and arms with cool water. If the temperature with this treatment be not sufficiently reduced, one or two thicknesses of muslin frequently wrung out of ice-water should be placed along the arms and upon either side of the face. By such local measures, which are agreeable to the patient and without shock or perturbing effect on the system, we can reduce the temperature two or three degrees. By adding alcohol or one of the alcoholic compounds to the water the popular objection to the use of cold is overcome.

Trousseau, in the treatment of sthenic cases attended by a high temperature, was in the habit of placing the patient naked in a bath-tub, and directing three or four pailfuls of water to be thrown over him in a space of time varying from one-quarter of a minute to one minute, after which he was returned to bed and covered by the bedclothes without being dried. Reaction immediately occurred, often with more or less perspiration. This treatment was repeated once or twice daily, according to the gravity of the symptoms. Trousseau, alluding to this treatment, says: "I have never administered it without deriving some benefit." But the application of cold water in a manner that does not excite or frighten the patient seems preferable. Henoch, having a large experience, gives the following advice in reference to the water treatment: "If the fever continue high and the apparently malignant symptoms described above develop, the head should be covered with an ice-bag. . . . . and the child placed in a lukewarm bath, not under 25° R. (88.25° F.). I decidedly oppose cooler baths, because in scarlatina, which presents a tendency to heart-failure, cold may produce an unexpected rapid collapse more than in any other affection. But I strongly recommend washing the entire body every three hours with a sponge dipped in cool water and vinegar."[1] In grave cases with a high temperature the application of cold should be sufficient to produce a decided reduction of heat, otherwise the full benefit from its use is not obtained. With proper stimulation and proper precautions, prostration does not occur from the ice-bags to the head and neck and cool sponging of other parts so long as the temperature does not fall below 102° or 103°. The danger alluded to by Henoch can only occur from the use of the pack or general bath, and the water treatment can be efficiently carried out and the temperature sufficiently reduced without resorting to these. Even Currie of Edinburgh, who first drew attention to the benefit from the cold-water treatment of scarlet fever in an age when the sweating treatment, and even the exclusion of cool and fresh air from the apartment, were deemed necessary, recommended cold effusion only in sthenic cases with full and strong pulse; and he mentions as a warning two cases with quick and feeble pulse and cool extremities in which death occurred immediately after the use of the water.

Sodium salicylate is in some instances a useful remedy for the reduction of heat in the infectious diseases. It seems to be more decidedly antipyretic than quinine in the febrile and inflammatory diseases, though somewhat depressing to the heart's action. James Couldrey writes to the *London Lancet* (Dec., 1882, p. 1064) that he has derived great benefit from its use in seven cases of scarlet fever. He administered it every two hours till ringing in the ears was produced, and afterward every four hours, prescribing one grain for each year in the age of the patient. It is, in my opinion, a proper remedy when the pulse is full and strong and the temperature is not sufficiently reduced by the cold-water treatment.

Aconite and veratrum viride reduce fever, but they are too depressing to be safely employed in grave scarlet fever, and their antipyretic effect is less than that of water. The use of digitalis might be suggested by the quick and feeble pulse in certain cases that are attended by high temperature, but the judgment of the profession is for the most part against its use in such cases. What Stillé and Maisch state of its employment in typhoid fever appears equally applicable to scarlet fever: "Even its advocates have not shown that it abridges the disease or lessens its mortality, while it is abundantly demonstrated to impair the digestion, reduce the strength, and even to occasion sudden death. The use of digitalis in other forms of fever is equally unsatisfactory, and justifies the judgment of Traube, that the true field of action for digitalis is not fever."

Quinine is the medicine which above all others has been heretofore most used, by almost common consent of the profession, to reduce the temperature in malignant scarlet fever, but its use for this purpose is, according to my observations, far from satisfactory. To obtain its antipyretic action it must be administered in large doses, and if any of the quinine salts in ordinary use be administered by the mouth in sufficient quantity, they are liable to be vomited. To a child of five years five grains should be administered twice daily by the mouth, or ten grains of a soluble salt, as the bisulphate, may be given per rectum, dissolved in a little warm water. Administered per rectum, it is frequently not retained unless held for a time by a napkin. When the antipyretic doses of quinine are discontinued, this agent may be prescribed as a tonic in doses recommended for the treatment of mild scarlet fever.

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[1] *Diseases of Children.*

Antipyrine and antifebrin are efficient and certain antipyretics, but in diseases attended by depression they are not safe remedies. When employed in such diseases the physician should visit the patient at short intervals, so that the medicine may be omitted if the action of the heart becomes feeble. When these agents are employed an alcoholic stimulant should be given at the same time. In my practice antipyrine has been more employed than antifebrin. If the patient have a temperature at or above 105°, not reduced by the cold bathing or by the sodium salicylate or quinine, and especially if the patient have jactitation and delirium, so that convulsions are imminent, the threatening danger may perhaps be averted by prescribing three to five grains of antipyrine, with double or treble its amount of bromide of sodium or potassium, to be given at intervals of three hours. The preferable antipyretic is, however, in my opinion, phenacetin, which can be given in powder every third hour in doses of two or three grains, with or without the bromide, to a child of five years.

In severe cases with frequent and rapid pulse, in which ante-mortem heart-clots are liable to occur, the ammonium carbonate is often useful. It should be dissolved in water and given in milk in as large doses as three grains every hour or second hour to a child of five years. It aids in producing stronger contraction of the cardiac muscular fibres, and thus diminishes the danger of the formation of thrombi. Ten-drop doses of the aromatic spirits of ammonia may be employed instead of the carbonate, given in sweetened water. It is especially useful if the stomach be irritable. A wineglassful of milk should be employed for this purpose, so that the medicine do not cause gastritis.

In severe cases attended by considerable angina and foul and offensive secretions upon the faucial surface an antiseptic, as boracic acid, in small quantity should be added to the potash and iron mixture recommended above. If no drink be allowed for a few minutes after the dose, so as not to wash it too soon from the fauces, the antiseptic effect is more certainly produced. Those old enough should be directed to hold the medicine for a moment like a gargle in the throat before swallowing it. I employ boracic acid by preference, as in the following formula:

℞. Acid. boracic., ʒss;
Potass. chlorat., ʒss;
Tr. ferri chloridi, fʒij;
Glycerini,
Syrupi, āā. f℥j;
Aquæ, f℥ij. Misce.

Sig.: Give one teaspoonful every two hours to a child of five years.

More minute directions will presently be given for the treatment of the pharyngitis when we speak of the complications.

Alcohol, whether administered in one of the stronger wines, as sherry, or in whiskey or brandy, is a most useful remedy in scarlet fever, and is indeed indispensable in all grave cases which are attended by feeble capillary circulation and evidences of prostration. Milk is also the best vehicle for this agent. The wine-whey or milk-punch should be given every hour or second hour. In scarlet fever, as well as diphtheria, comparatively large doses are required, as a teaspoonful of the stimulant every hour or second hour for a child of five years.

During convalescence the hygienic treatment already described is important. Nutritious diet and a moderate amount of alcoholic stimulants are required, while the patient is kept indoor and protected from currents of air as long as desquamation is occurring. More or less anæmia is present in most convalescent patients, so that a mild tonic containing iron will aid in restoring the health. Elixir of calisaya-bark and iron, preparations of beef, iron, and wine, or the liquor ferripeptonati in teaspoonful doses will be found useful under such circumstances.

Antiseptic Treatment.—As stated above, it is still undetermined whether or to what extent antiseptics, administered internally, antagonize and control the scarlatinous poison, and are therefore curative of scarlet fever. An important agent of this class, carbolic acid, can only be employed in small doses, for a dose much exceeding a drop for a child, or even exceeding a fractional part of a drop for a young child, might produce poisonous symptoms. Carbolic acid is a cardiac and arterial sedative, and it appears to reduce temperature. Intra-uterine injections of carbolized water in the treatment of puerperal fever are known to reduce temperature, even when there is no septic matter in the uterus to be disinfected and washed away, as in the case related to me in which the fever proved to be due to measles. It is not improbable that the antipyretic action in patients of this class who have no septic substance within the uterus is due largely, if not mainly, to the absorption of carbolic acid from the uterine surface and its sedative action on the vascular system. Whether this agent, so highly extolled by Declat, and to which I have alluded in a preceding page, can be safely employed in doses large enough to be efficient and curative, will be determined by future observations. Since scarlet fever resembles diphtheria in many particulars, it is a proper question whether the antiseptic remedies now largely used in the treatment of diphtheria, and with apparent benefit, may not be useful in scarlet fever. The sulphocarbolate of sodium has indeed been employed internally in scarlatina. with alleged benefit. Its antiseptic action is attributed to the carbolic acid in its composition, which is set free. It is certainly a useful remedy in severe anginose scarlet fever with fetid breath, whether used internally or as a gargle. It may be given in doses of five grains, dissolved in water, every three hours to a child of five years. In the gangrenous pharyngitis of scarlet fever probably the gargles or sprays of the corrosive-sublimate solution may be useful, as they are in diphtheritic pharyngitis. The apparent benefit derived from the internal use of corrosive sublimate in diphtheria suggests its internal use also in scarlet fever, but it has seldom been employed in this manner.

Treatment of Complications and Sequelæ.—Local measures designed to diminish or cure the pharyngitis are important in all but the mildest cases. They are more especially required in the anginose variety and in those not infrequent cases in which diphtheria complicates scarlatina. Formerly it was necessary, in making applications to the fauces, to employ the brush or probang for those too young to use the gargle, but hand-atomizers, as Richardson's or Delano's, which are now in common use, afford a quick and easy method for making such applications. Six or eight compressions of the bulb of a good atomizer are sufficient to cover the fauces with the spray. Those hand-atomizers in the shops which have slender metallic points are likely to prick the buccal surface and cause bleeding if the child resist and toss the head. To prevent this, I am in the habit of directing India-rubber tubing to be drawn over the point in such a way as not to obstruct its action. The

Following will be found useful mixtures for the atomizer: For ordinary cases,

℞. Acidi carbolici,	ʒss, vel. Acid. boracic., ʒij;
Potass. chlorat.,	℥j;
Glycerini,	f℥ij;
Aquæ,	f℥vj. Misce.

If the surface of the throat be covered by foul secretions,

℞. Acidi carbolici,	ʒss;
Potass. chlorat.,	℥j;
Glycerini,	f℥j;
Aquæ calcis,	f℥vij. Misce.

If diphtheritic exudation complicate the scarlatinous angina, or the surface of the throat in consequence of ulceration or necrosis present an appearance like that in diphtheria when the exudation begins to soften, being foul, jagged, of a dirty-brown appearance from dead matter and fetid secretions, those mixtures for spraying the throat will be found useful which are recommended in our remarks relating to the local treatment of diphtheria.

The following mixture is also beneficial for local treatment when the faucial surface is foul and offensive from the exudations and secretions. It should be applied by a large camel's-hair pencil every three to six hours:

℞. Acidi carbolici,	gtt. x;
Liq. ferri subsulphatis,	fʒij;
Glycerinæ,	f℥j. Misce.

In all cases of scarlatinous pharyngitis sufficiently severe to require special treatment, cool applications should be made over the neck from ear to ear, as by two thicknesses of muslin frequently squeezed out of cold water, or by the elongated India-rubber bag already recommended in our remarks relating to the methods to reduce temperature.

In the first days of scarlet fever the coryza is slight and no discharge from the nostrils occurs, so that no local treatment is required; but before the termination of the malady, in cases of ordinary gravity, a nasal discharge usually supervenes, producing more or less redness and excoriating the upper lip. Moreover, in localities where diphtheria occurs, if this malady complicate scarlet fever, it usually affects the nostrils at the same time that the fauces are invaded. These conditions require local treatment of the nares. It should be remembered that the Schneiderian membrane is midway in sensitiveness, as it is in location, between the conjunctival and buccal surfaces, and is readily irritated by strong applications. Medicinal applications made to it must be much milder than those which the fauces tolerate. They should always be applied warm, and a teaspoonful of any mixture properly employed is sufficient for each nostril at one sitting. The applications should usually be made every two to four hours, according to the gravity of the case and the amount of the discharge. The best instrument for this purpose is a small syringe of glass with curved neck and bulbous tip. The child's head should be thrown back and the piston depressed rapidly, so as thoroughly to wash out the nasal cavity. The application can also be made through an atomizer with a rounded tip or a tip covered by rubber tubing. The following is a useful prescription:

℞. Acidi borici, ʒj;
Sodii biborat., ʒij;
Aquæ puræ, Oj. Misce.

It is evident, from what has been stated above, that the condition of the ear should be closely observed in and after scarlet fever. If the patient have earache, considerable relief may be obtained in the commencement by dropping a few drops of laudanum and sweet oil into the ear and covering it by some hot application, either dry or moist, which will retain the heat. A light bag containing common table-salt, heated, or dry and hot chamomile-flowers, will also answer the purpose. Water as hot as can be well tolerated dropped into the ear or allowed to trickle from a fountain syringe, so as to fill the ear, is also very beneficial in allaying the pain. A 4 per cent. solution of nitrate of cocaine, with an equal quantity of laudanum, dropped into the ear, will often give considerable relief. If the hot applications over the ear are not well borne, Dr. C. H. May, aurist, recommends applying a long and narrow ice-bag immediately behind the auricle and extending under and in front of the ear, so as to cover the temporo-maxillary region, and at the same time instilling into the ear hot salt water (ʒj to Oj), to which laudanum or cocaine is added. He also states that antipyrine in large doses is also useful in relieving the pain.[1] If the pain be not quickly relieved, a leech should be applied at the base of the tragus. O. D. Pomeroy, an experienced aurist of New York, says: "Leeching employed at the right time rarely fails to subdue the pain and inflammation. The posterior face of the tragus is ordinarily the best place for applying the leech, but it may be applied in front of the ear or behind, wherever the tenderness on pressure is greatest. In my opinion, paracentesis may frequently be rendered unnecessary by the timely use of one or two leeches applied to the meatus."

If the otitis continue, as shown by pain in the ear, of which children old enough to speak bitterly complain, and which causes those too young to speak to press their fingers into or against their ears, this inflammation should not be neglected, as it may involve serious consequences. Multitudes of children have had permanent impairment or even loss of hearing, with caries or necrosis of the walls of the middle ear and of the mastoid cells, which might have been prevented by prompt and skilful management of the ear in the early stage of the inflammation. If, therefore, the otitis continue without mitigation of pain after the above measures have been employed, paracentesis of the drumhead is probably required. The following directions for performing this operation, which will be useful to country practitioners who may not be able to obtain the assistance of a specialist, are furnished by Dr. Pomeroy: "The forehead mirror should be worn, in order to leave the hand free to operate by either artificial or day light. A good-sized speculum is introduced into the meatus. Then an ordinary broad needle, about one line in diameter, with a shank of about two inches, such as oculists use for puncturing the cornea, should be held between the thumb and fingers, lightly pressed, so as not to dull delicate tactile sensibility. The part being well under light, the most bulging portion of the membrane should be lightly and quickly punctured with a very slight amount of force. The posterior and superior portion of the membrane is the most likely to bulge. The chordæ tympani nerve ordinarily lies too high up to be wounded. The ossicles are avoided by selecting a posterior portion of the membrane. After puncture the ear should be inflated by an ear-bag whose nozzle is inserted into a nostril, both nostrils being closed, so as to force the fluid from the tympanum. The puncture may need to be repeated at intervals of a day or two, provided that the pain and bulging return."

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[1] Pediatric Sec. of N. Y. Acad. of Med., March 14, 1889.

Albert H. Buck of New York, in a highly instructive paper read before he International Medical Congress in 1876, writes as follows of paracentesis of the membrana tympani in scarlatinous otitis: "In this one slight operation, which in itself is neither dangerous nor very painful, lies the power to prevent the whole train of disagreeable and dangerous symptoms." Buck relates an instructive example: The age of the patient was three years, and the earache had been complained of only about twenty-four hours. "Toward morning," says he, "I was sent for, as the pain had become constant. . . . An examination with the speculum and reflected light showed an œdematous and bulging membrana tympani (posterior half), the neighboring parts being very red, though as yet but little swollen. In the most prominent portion of the membrane I made an incision scarcely three millimetres (one-tenth inch) in length, and involving simply the different layers of the membrana tympani. This was almost immediately followed by a watery discharge (without the aid of inflation), which ran down over the child's cheek. At the end of three or four minutes the child had ceased crying, and in less than a quarter of an hour she was fast asleep. At first the discharge was very abundant and mainly watery in character, but it steadily diminished in quantity and became thicker, till finally, on the fourth day, it ceased altogether. On the tenth day the most careful examination of the ear could not detect any trace of either the inflammation or the artificial opening." The ear had probably been saved from ulceration of the drum membrane, long-continued suppurative otitis, and perhaps permanent impairment of hearing.

When an opening has been made in the membrana tympani, either by incision or ulceration, it is advisable in some instances to inflate the tympanum by Politzer's method, which has been alluded to above. The nozzle of an India-rubber bag with a flexible tube attached is introduced into the nostril on the affected side, and both nostrils are compressed against it. The patient fills his mouth with water, which he swallows at a given signal, as after the words one, two, three, spoken by the operator. During the act of swallowing, which opens the Eustachian tube, the rubber bag is forcibly compressed, which forces the air along the tube into the middle ear and facilitates the escape of the pent-up secretions in the tympanic cavity. Dr. May recommends cleansing the nostrils and pharynx with a warm solution of salt, one drachm to the pint, before the use of Politzer's bag.

If the otitis have continued unchecked by treatment until the secretions within it, after days and nights of suffering, have escaped by ulceration through the drumhead, the opportunity for prompt and certain cure is passed. Still, the patient under these circumstances may quickly recover, or there may be the other alternative described above, in which the ear is badly damaged and chronic inflammation established in the walls of the tympanum, giving rise to an offensive otorrhœa. In this state of the ear internal remedies are indicated, such as surgeons employ in suppurative inflammations of bone occurring in other parts of the system. Cod-liver oil and iodide of iron are required, especially by patients of strumous diathesis, the object being to promote a more healthy state of system, so as to prevent extension of the inflammation and facilitate the healing process. Carbolized solutions, as the following, syringed warm into the ear in which otorrhœa is occurring, are useful in promoting cleanliness and increasing the comfort of the patient:

℞. Acidi carbolici,	ʒss;	
Glycerini,	f℥ij;	
Aquæ,	f℥iv.	Misce.

But recently an effectual curative agent for local treatment has been discovered in boracic acid, by the use of which the discharge quickly diminishes and the condition of the ear more certainly and rapidly improves than by the use of the carbolized lotions.

℞. Acidi borici, ʒijss;
Glycerini,
Aquæ, āā. f℥j.
Sig.: Instil sufficient to fill the external ear three or four times daily.

The beneficial effects observed from the use of boracic acid in aural surgery have given it nearly the same position as a curative agent to diseases of the ear which atropine holds to diseases of the eye. Recently aurists are employing finely triturated powder of boracic acid dusted into the ear. The patient lies upon the side with the affected ear uppermost. The ear is thoroughly cleaned by syringing with tepid water, and by means of a little scoop made of stiff paper or pasteboard or the segment of quill as much of the powder is introduced into the ear as will cover a five-cent silver piece. By working the ear it descends to the drumhead. I can bear witness to its efficacy in the otorrhœa of children when it is used in this manner three times daily.

The following astringent has also been employed with good results for the otorrhœa resulting from scarlet fever as well as from other causes:

℞. Zinci sulphatis,
Aluminis, āā. gr. v;
Aquæ, f℥j. Misce.

A few drops of this should be dropped into the ear, or, if the ear be sensitive and painful, five drops should be added to a teaspoonful of warm water and dropped or syringed into the ear.

But in recent times aurists have discovered a remedy superior to the above in iodoform, the action of which is safe and efficient for protracted otorrhœa with granulations, and it is superseding to a great extent the agents heretofore used in the treatment of this disease. The ear should first be thoroughly cleaned by syringing with warm water and dried, and iodoform, to which a little balsam of Peru is added to mask the disagreeable odor, should be pressed down to the bottom of the auditory canal by any convenient instrument. It is anodyne, astringent, and disinfectant, and should be employed in a dry state in considerable quantity.

The sequelæ of otitis media, such as granulations sprouting out from the drumhead, some of which may be of large size and are known as polypi, may require treatment by the aurist. A polypus may sometimes be removed by the forceps, or, better, by the snare. Polypi not large and favorably located can sometimes be cured by an astringent powder, as iodoform, sulphate of zinc, or alum, or by applying the liquid subsulphate of iron. The otitis externa produced by the irritating discharge which flows from the middle ear soon disappears when the flow ceases.

The renal affection—which, as we have seen, so often commences in the declining period of scarlet fever or during convalescence in mild as well as severe cases—is frequently more dangerous than the primary disease. It largely increases the percentage of deaths. A clear appreciation of its therapeutic requirements is important, since by judicious treatment many recover who would inevitably be sacrificed by improper measures. The family should be informed that the danger from scarlet fever does not cease with the decline of the eruption, and that the kidneys may become seriously affected by too early exposure of the patient to currents of air or sudden changes of temperature, by which cutaneous transpiration is checked. He should therefore be kept indoor in a comfortable and uniform temperature three or four weeks after the termination of the fever, until desquamation has entirely ceased and the new epiderm is sufficiently thick and firm to protect the surface. During the changeable temperature of the autumnal, winter, and spring months even longer confinement at home may be advisable.

The nephritis and consequent albuminuria antedate by some days the occurrence of dropsy, and a physician should never discharge a scarlatinous patient without one or more examinations of his urine. When his visits cease the nurse should be instructed to make the examinations by heat and nitric acid during the ensuing month, and if any evidence, however slight, appear that the kidneys are involved, he should be notified, in order that appropriate treatment may be immediately commenced. Early and correct treatment of the nephritis is attended by much better results than delayed treatment, and many more patients are doubtless now saved than in former times, when little attention was given to the state of the kidneys until dropsy or other prominent symptoms appeared. I have found no mother or nurse so ignorant that she could not properly employ the test of nitric acid and heat, and if she be solicitous for the welfare of the child, she will not hesitate to carry out the directions and immediately notify the physician if the tests employed produce the least cloudiness or turbidity of the urine.

The patient as soon as nephritis commences, as shown by the state of the urine, should be put to bed in a room of warm and equable temperature (72° to 75° F.). His diet should be liquid, consisting of milk, farinaceous food, and a moderate quantity of animal broths. He may drink liquids freely, especially water not too cool, to which spiritus ætheris nitrosi is added. If he be prostrated by the primary disease, alcoholic stimulants should be allowed.

The indications are to relieve the hyperæmic kidneys by diaphoresis and purgation. To produce the former the patient should be immersed in a warm bath at about the temperature of the body (98° to 100°), in which, if he be quiet and comfortable, he should remain from fifteen to twenty minutes, but a shorter time if restless and frightened by the water, after which he should be placed in a warm bed and well covered by blankets. If perspiration result, the bath has been useful, and it may be employed in grave cases two or three times daily. If perspiration do not result, it may be produced by surrounding the body either by hot dry or moist air. Hot air may be produced by burning alcohol in a thin layer upon a plate under a chair, upon which the patient sits while he is surrounded by a blanket, or he may be covered in bed and the hot air introduced under the bedclothes. In New York a convenient apparatus is used for this purpose, consisting of a small sheet-iron pipe enclosed in a small box of the same material. The box is in the form of a trunk, with a handle for convenience in carrying, and the lower end of the pipe, which extends nearly to the floor, contains an alcohol lamp. Hot moist air may be produced by placing against the patient bottles of hot water surrounded by towels wrung out of water. The steam arising from them and enveloping the body and limbs produces a prompt sudorific effect. There is in use in this city, in the treatment of these and similar cases requiring diaphoresis, a convenient apparatus for generating steam. It consists of a cylinder pierced with holes for the admission of air and containing a spirit lamp, over which is a pan or pail holding a little water. The patient, nearly naked, is placed in a chair with the apparatus underneath, and is covered by a blanket, so that the steam surrounds the body. This gives rise to free perspiration, which continues after the patient is placed in bed. This treatment should be repeated one or more times daily, according to the gravity of the case.

The sudorific effect of the treatment by external warmth described above should be aided by employing diaphoretics. Those which have been most used are the acetates of ammonium and potassium, the bitartrate and citrate of potassium, and spiritus ætheris nitrosi. If employed when the surface is cool they act rather as diuretics than diaphoretics. These agents, being simple in their action and without deleterious effect, may be given frequently and in large proportionate doses for the age.

But lately a diaphoretic which far surpasses these in efficiency has been discovered in pilocarpine, the active principle of jaborandi. Being soluble in water and tasteless, it is easily administered, and is retained when, on account of the uræmic poisoning present in scarlatinous nephritis, the stomach is irritable and other medicines, as digitalis, are rejected. Ether may be employed with it, or the amount of alcoholic stimulant may be increased at the time of its exhibition in order to guard against any depressing effect. To a child of two years one-fortieth to one-twentieth of a grain may be given every six hours by the mouth. It may also be employed hypodermically, as one-twentieth of a grain to a child of five years. It has both a diaphoretic and a diuretic action, while it stimulates both the salivary and mucous secretions. According to one observer, an adult when fully under the influence of pilocarpine secretes from one pint to one quart of saliva within two hours, and Leyden reports a case of diphtheritic nephritis in which the quantity of urine rose from half a pint to five pints daily. But its most prompt and certain action is upon the sweat-glands. Hirschfelder speaks of its beneficial action in relieving various forms of dropsy, and adds: "In one morbid condition of the kidney, however, jaborandi is the remedy par excellence, and that is the acute parenchymatous nephritis which frequently follows scarlatina. . . . . This disease heals spontaneously if the danger that threatens life from reduction of the urine and from the effusions of fluid into the cavities of the body be averted. In this disease jaborandi works wonders." I have also found it an invaluable agent when the older remedies failed and death seemed imminent. The following cases, in which the beneficial action of this agent was apparent, occurred in my practice:

CASE 1.—G——, male, aged five years and six months, sickened with scarlet fever on June 2, 1882. It began with vomiting, and was attended by a degree of fever which indicated an attack of rather more than the average gravity. The fauces at one time exhibited a slight exudation like that of diphtheria. In the declining stage of the malady rheumatic pain and tenderness occurred in the wrist- and finger-joints, but not in those of the lower extremities. The case, however, progressed favorably, and during the convalescence my attendance ceased. On June 24th my attention was again called to the child, when the urine was found to be scanty and very albuminous. External measures, such as are described in the foregoing pages, were employed, and the infusion of digitalis with potassium acetate ordered to be given every three hours; but this medicine was for the most part vomited. The bowels were kept open by jalap and the potassium bitartrate. The urine, however, continued scanty, and on June 28th severe convulsions occurred. At this time the quantity of urine was only f℥ij in twenty-four hours. The pulse in the convulsions was quick and feeble. the skin very hot, and the axillary temp. 103°. The eclampsia continued one hour, and was controlled by large and repeated doses of bromide of potassium, aided by clysters of five grains of hydrate of chloral in water. Muriate of pilocarpine was now directed to be given in doses of one-thirty-second of a grain every three hours, dissolved in cold water. This agent was not vomited, and it must have been given by the parents in the fright and anxiety in larger or more frequent doses than were directed, for on July 1st the bottle containing one grain was empty. Free diaphoresis resulted from the pilocarpine, and the quantity of urine was increased. The mother stated that the child had taken only two doses, or one-sixteenth of a grain, of pilocarpine when the diuretic effect was apparent and free diaphoresis also occurred. She also stated subsequently that the quantity of urine was larger when the pilocarpine was administered every third hour than when given at a longer interval. A flaxseed poultice on which mustard was dusted was also applied over the kidneys. On June 20th the pulse was 96, temperature 100.5°; occasional convulsive attacks occurred, which were readily controlled by enemata of hydrate of chloral. On June 30th the symptoms were all better; no more attacks of eclampsia had occurred, and the urine was more abundant and less albuminous. The mother remarked that the new medicine (pilocarpine) had settled the stomach and increased the urine. The patient continued to improve, and on July 4th the record states: "Now takes the pilocarpine, gr. $\frac{1}{32}$, every six hours; passes urine freely since yesterday; has not vomited since he began to take the pilocarpine; pulse 106°, axillary temp. 99°; is playful and takes milk freely, nearly three quarts in twenty-four hours, with some farinaceous food. Digitalis with potassium acetate is also given in occasional doses." July 6th, pulse 92, temp. 99°; perspires much, and urine nearly normal in quantity and character.

CASE 2.—Mary S——, aged five years, on Dec. 22, 1882, presented the symptoms of severe nephritis. Her brother had scarlet fever two weeks previously, and she had sore throat at about the same time, but without efflorescence; pulse 98, temperature 98.5°; her urine highly albuminous, and reduced to f℥iv in twenty-four hours; bowels constipated. Ordered a single dose of

℞. Hydrarg. chlor. mitis, gr. iij;
Resin. podophylli, gr. $\frac{1}{8}$. Misce.

The muriate of pilocarpine was also ordered, gr. $\frac{1}{20}$, but the patient vomited soon after taking it. Another dose was retained, and was followed by considerable perspiration. Dec. 23d, had one stool from the powder of yesterday. Has taken five doses of pilocarpine, but vomited after three of them. The last dose was administered at 10 P. M., and the mother says she "sweat fearfully" during the night. The patient was kept warm in bed; stimulating poultices of mustard and flaxseed, one to sixteen, were constantly in use over the kidneys, and the pilocarpine was administered three or four times a day. The record for Dec. 26th states: "Took the pilocarpine four times since yesterday morning, and each dose is followed by perspiration lasting from one to one and a half hours; quantity of urine, from f℥vj to f℥viij daily; vomited twice yesterday, not to-day; pulse 104; temp. 97.75°; complains of frontal headache; bowels regular; has considerable salivation. The patient is warm in bed, and the flaxseed and mustard poultice over the kidneys is continued." Dec. 28th, specific gravity of urine 1019: urine still quite albuminous and containing blood-corpuscles and granular casts, also crystals of oxalate of lime. Dec. 30th, takes gr. $\frac{1}{20}$ pilocarpine twice daily, and occasional doses of infusion of digitalis; urine more abundant; its specific gravity 1014, slightly albuminous, and containing very few granular casts and blood-corpuscles; has lost its smoky appearance; reaction alkaline; perspiration slight; patient convalescent.

In another instance a child of five years, from three to four weeks after scarlet fever, was noticed to have anasarca of the face and extremities, with scanty and albuminous urine. One-thirty-second of a grain of muriate of pilocarpine was administered every six hours without the desired sudorific effect. It was then administered every four hours, with an increase of perspiration and urination, so that the nephritic symptoms were relieved and the patient apparently out of danger within three or four days.

In a fourth patient, a girl of three years having scarlatinous nephritis, with symptoms very similar to those in the last case, the administration of one-twentieth grain doses of pilocarpine in conjunction with the hot-air bath was followed by increased perspiration and urination, and progressive and rather rapid convalescence. This child had been taking bichloride of mercury in one-fiftieth grain doses, prescribed by a homœopathic physician, without appreciable benefit, it having been for the most part vomited.

Given, as in the above cases, in moderate doses and with sufficient interval, pilocarpine has never in my practice had any deleterious effect, and I regard it as a very important addition to the remedies for the relief of scarlatinous nephritis. It is apparently the most useful and important diaphoretic for this disease which we possess.

Cathartics, especially those of a hydragogue nature, are also very beneficial. Their action is more certain than that of most diaphoretics and diuretics, and their employment is imperatively required in severe or dangerous cases in which it is necessary to remove as soon as possible the serum or urea which endangers life. Young children or those with delicate stomachs and those much enfeebled by the primary disease may take magnesia, either the citrate or the calcined. A good cathartic for ordinary cases is a mixture of jalap and potassium bitartrate, the pulvis jalapæ compositus, consisting of one part of jalap and two of cream of tartar. Ten grains of the mixture may be given to a child of five years, and repeated according to circumstances. Its effect is increased by dissolving a teaspoonful of potassium bitartrate in a gobletful of water and allowing the patient to drink from it. The following cathartic also acts promptly and beneficially in the treatment of scarlatinous nephritis:

℞. Ol. cinnamomi, gtt. v;
Magnes. sulphat., ℥j;
Potass. bitartrat., ʒij. Misce.

Dose: One teaspoonful repeated from two to four hours until catharsis occurs.

After the use of laxative agents the kidneys, being less congested on account of the diversion that has occurred, often begin to excrete urine more freely. But if the patient be anæmic or enfeebled and the symptoms are not urgent, it is frequently better to avoid active catharsis, which more or less reduces the strength, and employ remedies of a sustaining character, as in the following case, which occurred in my practice: A little boy, pallid and scrofulous, began to have anasarca after scarlet fever, chiefly in the scrotum, accompanied by a moderate degree of ascites. The urine, which was passed in nearly the normal quantity, contained albumen, but not in large amount. This patient gradually and fully recovered, with no treatment except the use of an oil-silk jacket over the kidneys and abdomen to promote diaphoresis, and the use of iron. Such a patient, treated by the powerful eliminatives which we employ for the more urgent and robust cases, would probably have been injured rather than benefited. No treatment can therefore be recommended in a treatise on scarlatinous nephritis which will be strictly applicable for all cases. Variations are demanded according to the state of the patient and the form and gravity of the disease.

Diuretics which do not stimulate the kidneys are proper at an early as well as late period of the renal malady, and digitalis is the one usually prescribed. I do not hesitate to order it from the first day in combination with the acetate of potassium. One teaspoonful of the infusion may be given every third hour to a child of five years. The following formula is for one of this age in good general condition:

℞. Potass. acetatis, ℥ss;
Infus. digitalis, f℥vj. Misce.

The following formulæ are recommended by Meigs and Pepper:

℞. Potass. bitart., ʒj;
Spt. junip. comp., fʒij;
Spt. æther. nitros., fʒj;
Tr. digitalis, ♏xv;
Syrupi, f℥v;
Aquæ, f℥ij. Misce.

Dose: One teaspoonful every two hours to a child of two to four years.

℞. Potass. acetat., ʒj;
Tr. digitalis, fʒss;
Syr. scillæ, fʒi–j;
Syr. zingib., fʒv;
Aquæ, q. s. ad f℥iij. Misce.

Dose: A teaspoonful every two or three hours to children two or three years old.

Local treatment is important. L. Thomas, Romberg, and others recommend the application of leeches, three or more, over the kidneys. Thomas says: "In many cases the abstraction of blood causes immediate and permanent relief; the fever and the pain in the region of the kidneys cease, the secretion of urine becomes augmented, the albuminuria lessens from day to day, and the moderate degree of dropsy that has been developed disappears." It is only in the more robust children, who have been but little reduced by the primary disease, that leeching is, in my opinion, admissible. In the majority of cases instead of depletion a poultice slightly irritating, so as to cause redness of the skin, should be applied over the kidneys, or for older children, not likely to be frightened by the process, the dry cups may be applied daily. In subacute cases, not attended by any alarming symptoms, sufficient redness may be produced by one of the irritating plasters which the shops contain, constantly worn.

Eclampsia, described in the preceding pages, is produced, as we have seen, during the course of scarlet fever by the irritating effect of the scarlatinous poison upon the nervous centres; but, occurring after the decline of scarlet fever, it is ordinarily produced by the retained urea. The same remedies are required to control the convulsive movements as when they occur under other circumstances. The bromide of potassium should be immediately administered in large doses whenever eclamptic symptoms arise. During eclampsia a child of three years should take five grains of this agent every five to ten minutes till the attack ceases, and then at longer intervals. The hydrate of chloral is a more powerful agent, and if the eclampsia be not quickly controlled, I commonly employ it per rectum, dissolved in one or two teaspoonfuls of water. For a child of three to five years five grains should be thrown into the rectum by a small glass or gutta-percha syringe, and retained by pressure. Properly administered and retained, it rarely fails to control the eclampsia within ten or fifteen minutes. Subsequently, occasional doses of the bromide should be given to prevent the occurrence of eclampsia while the measures described above are being employed to eliminate the urea.

Rheumatism, endocarditis, and pericarditis, arising as complications or sequelæ, require the treatment which is appropriate when they occur under other circumstances, but the remedies should not be depressing, as the system is already enfeebled by the primary disease. The rheumatism, if mild, usually abates in a few days without medication, and the affected joints require only some soothing lotion and support by a bandage. The following liniment may be applied upon muslin and covered by cotton wadding:

℞. Acid. carbolici, fʒj;
Tinc. belladonnæ, f℥j;
Ol. camphorati, f℥ij.

If the rheumatism be severe and affect several joints, the sodium salicylate should be prescribed, as in the idiopathic disease, with an occasional opiate to procure rest.

Endocarditis and pericarditis require rest in the horizontal position, avoidance of all excitement, the use of the tincture or infusion of digitalis or the tincture of strophanthus to procure a slow and steady action of the heart. Three drops of the tincture of digitalis or one to one and a half drops of the tincture of strophanthus may be given every four hours to a child of five years. The same external measures should be employed as in acute pleuritis. I prefer the application of a thin poultice of flaxseed containing one-sixteenth part of mustard and covered with oiled silk. The cardiac inflammations, as well as rheumatism, require opiates in sufficient doses to procure rest and sleep.

Pleuritis, which we have stated is often suppurative, demands the same treatment as the idiopathic disease when it occurs in cachectic patients.

CHAPTER III.

RÖTHELN.

This disease has also been designated rubella, epidemic roseola, rosalia, rubeola notha, and German measles. Some recent writers incline to the belief that it occurred in Europe in the eighteenth century, having the name rubeola. Thomas states that, according to Formey, 457 died from rubeola, 172 from scarlet fever, and 53 from measles in Berlin in the decade beginning with 1784; but he also states that many who observed these epidemics believed that the rubeola was a species of measles. We infer that this was the correct opinion, and that the rubeola of the eighteenth century was not the rötheln of the present time, since the latter is almost never fatal, except from complications. In Great Britain, from the year 1840 onward, various writers, when treating of measles and scarlet fever, make statements which lead us to think that they may have sometimes mistaken epidemics of rötheln for modified forms of measles or scarlet fever. Perhaps it is not too much to claim that the first clear and distinct differentiation of rötheln was made in this country. Cases of rötheln occurring in and about Boston were described by Dr. Homans, Sr., in 1845, and at a later date—to wit, in 1853 and 1871—B. E. Cotting and Mr. D. Howard saw cases, and described them in papers read before local societies (*Bost. Med. and Surg. Jour.*, March 15, 1873). In 1874, Dr. Caleb Green of Homer, Cortland co., New York, an accurate and intelligent observer, also witnessed an epidemic.

Rötheln was not, however, noticed in American treatises, and it scarcely received recognition in America, until an epidemic of it occurred in the New York Foundling Asylum and in New York City in 1873–74, which furnished the material for a paper published in the *Archives of Dermatology* in 1874. This epidemic began in the latter part of 1873, and attained its maximum in March and April, 1874, after which it gradually declined. This, so far as I can learn, was the first occurrence of rötheln in this locality. In a general practice of more than twenty years, extending over a considerable portion of this city, I had previously seen nothing like it, and other older physicians, having a large general practice, informed me that they considered it an entirely new disease with us. Those who believed that they had occasionally observed isolated cases of it previously to this epidemic probably referred to roseola.

The first case which I observed occurred in the middle of December, 1873, in West Seventy-first street, in the northern suburbs of New York. A few weeks later cases were so numerous in the more thickly-populated section of the city as to attract the attention of many physicians. It was evident that a disease had appeared with which we were not familiar, and as the eruption occurred in points and small circumscribed patches, it was usually designated by the physicians, in want of a more accurate name, epidemic roseola, or was spoken of as a spurious measles. Physicians who were familiar with foreign medical literature saw the resemblance between these cases and those of rötheln as described by British and continental writers, but in certain at least of the foreign cases the duration of the rash was said to be seven days (Liveing, *London Lancet*, March 14, 1874, and *Med. News and Library*, May, 1874), whereas in the cases in New York it commonly disappeared by the fourth day. This discrepancy, however, was not sufficient to invalidate the belief in the identity of the New York disease with the foreign rötheln. It was readily explained by the difference in the seasons in which the cases occurred, for Liveing observed his cases in June and July, and, as we will see, the greater the external heat the longer is the duration of the eruption.

Between the middle of December, 1873, and May 1, 1874, I had observed and treated this malady in eighteen families. Cases occurred in three other families living in the same houses with some of those which I attended, and, as they were fully and clearly described to me, so that there could be no doubt as to their nature, I have included them in my statistics. The total number of cases in these twenty-one families was 48. During May, when the epidemic was declining, I saw 6 additional cases, occurring singly, making a total of 54. Their ages are given in the following table:

Age.	Cases.
From eight months to one year	2
" one year to two years	4
" two years to five years	16
" five years to ten years	23
" ten years to fifteen years	3
" fifteen years to thirty years	6
Total number of cases	54

The age of the youngest patient was eight months and that of the oldest thirty years: 72 per cent. of the total number were between the ages of two and ten years, so that rötheln is pre-eminently a disease of childhood. Individuals in and beyond the middle period of life seem to have nearly an immunity from it. The age of the oldest patient of whom I was informed in the epidemic of 1873 and 1874 was about forty years. On March 25, 1873, during my attendance in the New York Foundling Asylum, rötheln appeared in a boy of four years; in the following month about thirty more cases occurred in this institution, all children, while among the large number of female nurses and employés, who were chiefly between the ages of twenty and thirty years, all but three escaped.

From 1874 to 1880 rötheln did not prevail in New York, unless now and then an isolated or sporadic case, the nature of which was not recognized and which was supposed to be roseola. On August 9, 1880, two cases appeared in different wards of the New York Foundling Asylum, when it was remembered that two weeks previously these children had been exposed to a patient in the hospital attached to the institution who had what the physician in attendance supposed at the time to be roseola.

Commencing with these two cases, an epidemic occurred in the asylum, mild in type, affecting only a few at a time, but extending over several months, until about sixty inmates, chiefly children, were attacked. Toward the close of 1880 rötheln began to appear in the northern part of the city, in which the asylum is located and over which my practice extends. Its maximum prevalence was attained in the latter part of March and April, 1881, when it particularly attracted the attention of physicians. A large proportion of the children attending certain public and private schools were attacked. It occurred in seventeen families in my practice. The ages of the patients in these families are given in the following table:

Age.	Cases.
From one to two years	3
" two to five years	8
" five to ten years	18
" ten to fifteen years	11
There were 2 cases over fifteen years, aged respectively twenty-two and forty-two years	2
Total number of cases	42

Premonitory Stage.—Premonitory symptoms are in most instances absent or so mild as to attract but little attention. It not infrequently happened in the New York epidemics that the parents or the teachers in the schools were first made aware of the illness of the children by observing the eruption. In some instances children were sent from school, not because they felt too ill to remain, but on account of the unusual appearance of the skin. Sometimes, however, in those old enough to express their sensations a premonitory stage of some hours or a day, or even of longer duration, was present, consisting of such symptoms as usually occur when one has taken a severe cold, as languor, pain in the head, trunk, or limbs. The resident physician of the New York Foundling Asylum was so ill with rötheln that he was confined to his bed during the first day of the disease. Now and then patients experience nausea previously to the eruption and in the first and second days of the eruptive stage. In only one instance did I observe grave prodromic symptoms. A boy aged eight years was suddenly seized with clonic convulsions, and while in a warm bath for the relief of these the rash appeared upon those parts of the body which were immersed in water.

Symptoms.—*Tegumentary System.*—(*a*) *The Skin.*—The eruption commonly commences upon the forehead, around the ears, and along the neck, as in measles. Occasionally it may appear upon the back or chest, as in the above-mentioned case, in which the hot water accelerated its appearance. Commencing above, the efflorescence travels downward, appearing after some hours upon the lower part of the trunk and on the legs, resembling in this respect the eruption of measles and scarlatina. It occurs upon all parts of the integument except the scalp and palmar and plantar surfaces. In the majority of the cases which I have seen it gradually faded away, disappearing by the fourth day, but in children who were kept warm in bed or in warm apartments it remained longer than on others. In many instances traces of the rash were still visible several days after recovery when the patients were heated by exercise or excitement. It reappeared at times, though indistinctly, on a girl of thirteen years for three weeks. In most of the cases in the New York epidemics the eruption commonly occurred in points and circular spots somewhat smaller than those of measles. These points and spots were numerous and thickly set, so that, in the aggregate, they covered at least half of the surface, while between them the skin presented nearly or quite its normal appearance. The general aspect in most cases was more like that of measles than that of scarlatina, but in exceptional instances the skin between the points and spots had a redness similar to that of erythema, and the resemblance was very like the scarlatinous efflorescence. Thus, in a boy of three years the eruption so closely resembled the scarlatinous over the trunk that were it not that the temperature was constantly below 100°, and the fever entirely ceased within three or four days, I would probably have considered the malady a mild scarlatina. In certain patients the eruption, beginning in circumscribed spots, like that of measles, becomes in two or three days confluent, so as to resemble that of scarlatina, while over other parts the spots remain discrete. This was the character of the eruption upon the third and fourth days on the extremities of a little boy in the Foundling Asylum. The rash is attended by considerable itching, from which, indeed, many patients suffer more than from all other symptoms.

The eruption disappears on pressure, produces a slight roughness of the surface, as ascertained by passing the fingers gently over it, and usually fades away without desquamation. Exceptionally, there is a slight branny exfoliation, and in one of my patients the exfoliation was as great over the abdomen as in cases of scarlatina.

(*b*) *The Mucous Membrane.*—In connection with the cutaneous eruption a mild inflammation also occurs upon the mucous membrane covering the fauces, buccal cavity, and nostrils, and upon reflections of this membrane over the eyes and eyelids—*i. e.* upon the conjunctiva. In certain patients this inflammation is scarcely appreciable, but in the majority it arrests attention at once. It produces a suffused, reddish, or weak appearance of the eyes, with a moderately increased lachrymation. On everting the eyelids the palpebral conjunctiva is seen to be injected. In certain patients a moderate puriform secretion collects at the inner angle of the eyelids. In occasional cases the conjunctivitis causes œdema of the lids, usually slight, and likely to be overlooked by the physician; but in three instances which I now recall to mind the mothers of the children directed my attention to the swollen state of the lids. In one of these, an infant of twenty-three months, the tumefaction was so great, commencing about the time the eruption began to fade, that light was totally excluded from the eyes and it was impossible to ascertain their condition. The skin over the eyelids retained nearly its normal appearance, and a puriform secretion appeared between the lids. In three or four days the œdema of the lids and the hyperæmia of the conjunctiva rapidly declined. The coryza is in most cases sufficient to cause an unpleasant sensation in the nostrils and provoke sneezing; but the flow from the nostrils, though present, was in no instance under my observation as abundant as in ordinary cases of scarlatina or even of measles. The fauces present an injected appearance, and in severe cases there is moderate swelling of the tonsils. The same catarrhal hyperæmia is also seen in spots or patches, more or less diffused, upon the buccal surfaces. Both the faucial and buccal catarrh are less in degree, however, than in cases of rubeola and scarlatina, which have an equal intensity of cutaneous eruption; and this fact aids in differential diagnosis.

The Respiratory System.—In both the epidemics which I have witnessed the mucous membrane of the larynx, trachea, and bronchial tubes participated only slightly in the inflammation which involved the nasal, buccal, and faucial surfaces. Many of my patients had no cough, but others had a mild cough, lasting a few days, but with normal respiration. It was due apparently to a very mild catarrh of the respiratory tract at the time when the nasal and conjunctival surfaces were the most affected. It subsided in a few days without treatment. In no case do I recollect that there was any hoarseness.

The Digestive System.—The tongue in rötheln is moist and of normal appearance or covered by a slight fur. The appetite may be impaired, but is not wanting in uncomplicated cases. The patients sometimes say that it is nearly the same as in health; the thirst is slight, and the bowels are regular.

Nausea is not infrequent, and vomiting was, in several cases in my practice, one of the initial symptoms. In certain patients it also occurred on the first or second day of the eruption. In others there was no nausea, so far as I could learn, either immediately before or during the prevalence of the disease. This symptom is less frequent in rötheln than in scarlet fever, but is as common apparently as in measles. I have never found albumen in the urine, though I have examined that passed by several patients. This secretion did not appear to be abnormal except as it contained urates, so common in febrile states.

The Pulse and Temperature.—The largest number of accurate daily observations relating to the temperature was, I think, that of Dr. Reid in the New York Foundling Asylum during the month of March, 1874. He has kindly furnished me with his statistics relating to this symptom, as follows: "The number of closely-observed cases in which the temperature was taken was 24. In 17 of the cases the temperature ranged from 97° to 99°; in 6 it reached 100°, 100¼°, and 100¾°; in 1 it reached 103¼° on the second day of the eruption, but remained so elevated only one day." In certain patients Dr. Reid observed what he designates "a tendency to the development of an ephemeral fever." These observations correspond closely with those made by myself during the same epidemic. Thus, in 16 cases I found the axillary temperature taken each day to be constantly between 98° and 100°, with a pulse under 110, except in 1 case, in which it numbered 124. In certain other patients a more decided rise of temperature from one to two or three days occurred, usually in the commencement of the malady. Thus, a girl aged three and a half years had a temperature of 101¾° and a pulse of 128. In another instance the pulse was 124 and the temperature 102°. In another, a girl of three and a half years, considerable fever occurred without apparent cause on Saturday night, but it abated on the subsequent day. She seemed well until the following Tuesday, when the fever returned and the eruption appeared. On Thursday the temperature from 102° to 103° fell to 99½°, and within a day or two she was convalescent. In two other patients from two to four days after the disappearance of the eruption an accession of fever occurred, lasting about one day, and attended by pain and distress in the epigastric region, but without vomiting or diarrhœa. In one of these the temperature was 103¾°, the pulse 130 per minute. In the other case the temperature and pulse did not seem to be under these figures, but were not accurately ascertained. Occasionally the fever is due more to complications than to the primary disease. Thus, in two of my patients the rise of temperature was mainly attributable to diphtheritic inflammation which had attacked the fauces. But while the fever in rötheln is ordinarily of short duration, in certain patients temporary exacerbations may occur in which the temperature is as high as in scarlet fever or measles.

COMPLICATIONS; PROGNOSIS.—The only complication which occurred in cases in my practice has already been alluded to—to wit, diphtheria, which, when prevalent, usually attacks surfaces already inflamed. In the Foundling Asylum varicella complicated one case and pneumonia another. In a third pneumonia occurred about three days after the disappearance of the eruption. The prognosis in uncomplicated cases is always very favorable, and there is no liability to sequelæ more than in mild catarrhal inflammations of a non-specific character. The duration of rötheln is short, not ordinarily extending beyond three to five days.

NATURE; INCUBATIVE PERIOD; CONTAGIOUSNESS.—Is rötheln a distinct malady, or one with which we are familiar, but the form and character of which are modified by unusual meteorological conditions? Is it roseola assuming at certain periods an epidemic character and appearing to be contagious? Or is it at all times infectious, possessing a specific principle, and, like other infectious diseases, self-propagating? Should it in nosological classification be placed among the non-contagious and local or among the constitutional and infectious maladies? Let us consider the facts observed in the New York epidemics.

The first cases of rötheln in this city were often designated roseola by the physicians called to treat them, since they seemed to resemble more closely this disease than any other with which they were familiar. But rötheln differs widely from the peculiar form of dermatitis known as roseola. The successive occurrence of the eruption over the upper and then the lower parts of the body, but covering the whole surface, and the definite duration of three to five days, are points of difference. Moreover, roseola would not, without so great a change in its character as to become virtually a distinct disease, occur in the cool months, without any appreciable dietetic cause, as an epidemic over a certain area and for a limited time, affecting whole households and sparing other households as well as individuals of a certain age. We therefore consider it distinct from roseola.

Most of the cases of the New York epidemics bore considerable resemblance to measles, both as regards the appearance and duration of the eruption and the catarrh of the mucous surfaces. Parents often diagnosticated measles before the arrival of the physician, and the physician himself, at first glance, sometimes made the same diagnosis. But in rötheln the shortness and mildness of the stage of invasion, the absence of cough or the presence of one trivial and scarcely noticed, appetite good or but slightly impaired—in fine, symptoms that are transient or slight—afford a striking contrast to the graver symptoms of measles. But the decisive proof that rötheln is not a modified measles is found in the fact that one does not prevent the other. Of the 48 cases observed by myself prior to May 1st in the epidemic of 1874, 19 at least had had measles, and 1 who had rötheln took measles subsequently. I have already stated that in the New York Foundling Asylum rötheln in 1873 and 1874 closely followed an epidemic of measles. A considerable number of the children attacked by the former disease had recently recovered from the latter. During the epidemic of 1880 and 1881 the same fact was observed—namely, that a previous attack of measles as well as scarlet fever afforded no protection from rötheln. Dr. Chadbourne, the resident physician, writes of the cases in the Foundling Asylum in 1880 and 1881: "Eight children had rötheln who had had both scarlet fever and measles within six months under my observation, while certain others had had these diseases at some previous time." Of the cases observed by myself in family practice in the same epidemic, it is stated in my notes that ten had had measles. These statistics are sufficient to show that rötheln is a distinct disease from measles, however close the kinship.

That rötheln is not a form of scarlet fever is evident from the fact that as regards at least the New York epidemics the rash was in most instances quite distinct from the scarlatinous efflorescence, occurring, as we have said, in small more or less circular points and patches. Moreover, as we have remarked above, there is in rötheln a slight febrile movement and general mildness of symptoms which contrast with the high fever and other pronounced symptoms of scarlatina, or if there be considerable febrile movement its duration is brief. But the conclusive proof of an essential difference between these two diseases is found in the fact already stated in reference to measles, that the attack of the one malady does not prevent the occurrence of the other. There are, it is true, cases in which it is difficult at first to make the differential diagnosis between rötheln and mild measles or *mild scarlet fever, but when* the course of the malady has been closely observed for three or four days, it will rarely happen, I think, that we will be unable to make out its character.

Those cases of an epidemic which arise when the causes or conditions from which it is developed are most strongly operative, and which at this time are likely to be typical, obviously afford the best data for studying its nature. Such were the 48 cases which I saw in the epidemic of 1873 and 1874, and the 42 in that of 1880 and 1881. As regards the former epidemic, in thirteen of the twenty-one families embraced in my statistics the first cases were children who up to the time of the seizure were attending public and private schools, and in certain instances those who were nearly simultaneously attacked, living perhaps in streets widely separated, were attending the same school. During the epidemic of 1880 and 1881 the first patients in thirteen of the eighteen families in which rötheln occurred in my practice were school-children between the ages of six and twelve years, and in most, if not all, the different schools which they attended rötheln was at the time prevailing as an epidemic, as I ascertained on inquiry. It therefore seemed probable that these children whom I attended had contracted it from others in the schools.

In both the New York epidemics during the time that rötheln was at its maximum prevalence, in most of the families containing two or more children the cases were multiple, not occurring simultaneously, but in succession, as if the malady were contracted from those first affected. This is what we daily witness in the spread of exanthematic fevers. Thus in Mr. E——'s family a girl attending one of the public schools took rötheln in the middle of December, 1873; the two remaining children sickened with it one week and two weeks later. A niece visiting in the family at the time when the first child was sick, but returning home to another street, also had the eruption on December 27th. Alice R——, aged ten years, a frequent visitor at Mr. E——'s, living in the same street, and several times exposed to his children during their illness, also took rötheln about January 4th. West Seventy-first street, where these cases occurred, was thinly settled and suburban, and I could learn of no other cases in the vicinity. A child of Mr. P——, aged five and a half years, had been in the habit of playing with two children two doors away, who became affected with rötheln in the beginning of April, 1881. On April 14th he was supposed to have a mild coryza from taking cold, as he sneezed often, but in a few hours the efflorescence appeared. Four days subsequently, on the 18th, an infant was affected in the same way, and thirteen days later another child in the family, aged twelve years. In a similar manner rötheln occurred in the families of two brothers living in adjoining houses in West Fifty-first street. The first patient was a boy of twelve years. It appeared successively in the children of these two families until ten had been affected. In a family in West Forty-sixth street the first case was a boy attending a school in which rötheln was prevalent. Within twenty days—namely, between March 31st and April 20th—four other children were attacked in succession.

These facts and cases seem to demonstrate the contagiousness of rötheln, at least during the time in which the conditions are most favorable for its development or during the time in which the epidemic influence is most pronounced. In the declining period of both the New York epidemics the cases which I observed occurred for the most part singly, although there was no attempt to isolate the patients, so that the contagiousness of the disease must be slight.

Rötheln is, in my opinion, an exanthematic fever feebly contagious. It resembles varicella in general mildness of symptoms, in the absence of dangerous complications or sequelæ, and in the uniformly favorable prognosis, while its symptoms show a resemblance to measles and scarlet fever.

If the above view be correct, rötheln must possess an incubative period which, in the cases observed in both epidemics, apparently varied between seven, or perhaps less than seven, and twenty-one days. Its incubation, therefore, like that of scarlet fever and diphtheria, apparently varies in different patients. In the cases which came under my notice the incubative period, when it could be accurately ascertained, was more frequently about two weeks than a longer or shorter period. The resident physician of the New York Foundling Asylum, when the epidemic was prevailing in that institution, returned to his home in the State of Maine to a locality where rötheln was unknown. Fourteen days from the date of his departure he was himself affected with the disease in its typical form. No other case occurred at his home, where probably the atmospheric conditions were unfavorable. Minnie B——, attending a school in which there were many cases, had the rash on April 5th. On the 23d of the same month, eighteen days afterward, it appeared upon the servant who was frequently in Minnie's room. Elizabeth C——, attending a school in which rötheln was prevailing, had the eruption on April 17th. It commenced upon her sister thirteen days, and upon her mother fourteen days, subsequently.

Other cases might be cited of an apparently shorter as well as longer incubative period. The following note from Dr. Chadbourne of the New York Foundling Asylum, bearing upon this subject, is interesting: "I am led to believe from my observations that the period of incubation was, in the majority of cases, from twelve to fifteen days. The disease has been very feebly contagious. In some cases one child would have rötheln, while the other, nursed by the same woman, escaped. In two instances women had the disease, and though each suckled two infants, the latter escaped." Osborn states that enlargement of the small glands at the edge of the hair on the postero-lateral sides of the neck has been present in all the cases which he has observed, and he therefore considers it an important diagnostic sign (*Weekly Med. Rev.*, Dec. 24, 1887). Several other writers have also observed this glandular enlargement, and some have stated that it occasionally precedes the efflorescence. Swelling of the lymphatic glands in other parts of the system has also been recorded by different observers, and it rarely goes on to suppuration. It usually subsides with the disappearance of the rash, but Golson has observed the occurrence of abscesses in the site of the submaxillary lymphatic glands. Curtman has also observed the formation of abscesses in various parts of the body.

COMPLICATIONS.—Recent writers have recorded a considerable number of complications and sequelæ, the more important of which we will briefly enumerate as follows, but the occurrence of some of them was a coincidence: severe bronchitis, pneumonia, pleurisy, enteritis, entero-colitis, colitis, icterus, stomatitis, rheumatism, meningitis, abscesses, miliaria, pemphigus, erysipelas, œdema, enlargement of the thyroid, otorrhœa, earache, and keratitis. Some of these complications are such as frequently occur in measles, to which, as we have seen, rötheln bears considerable resemblance.

DIAGNOSIS.—Rötheln might readily be mistaken for roseola if only a few and isolated cases occur, but the longer continuance of the eruption, the catarrhal symptoms, though slight, and in most instances the evidence of contagion, enable us to make the diagnosis. From measles this disease is distinguished by the absence of, or slight and transient character of, the prodromal stage. The fever with evening exacerbations, the cough, and pronounced catarrhal symptoms, which precede the rash in measles three or four *days, do not occur in rötheln.* The diagnosis from mild scarlet fever in the commencement of an epidemic, when only a few cases are observed, may be difficult, but no epidemics of scarlet fever occur in which the type remains so mild as in rötheln. The shorter duration of the rash, the absence of the initial vomiting and of the strawberry tongue, the usual roseolar rather than erythematous character of the rash, the mildness, sometimes scarcely appreciable, of the stomatitis and pharyngitis, the slight indisposition, so that the child, if it followed its inclination, would not be under restraint, and the absence, with few exceptions, of complications and sequelæ, usually render the diagnosis from scarlet fever clear and unmistakable.

PROGNOSIS.—Death does not occur except from some complication or intercurrent disease. When Forney stated that in Berlin during the decade ending with 1794, 457 died from rubeola, 172 from scarlet fever, and 53 from measles, he could not by the term "rubeola" have referred to rötheln, as some have supposed, or the nature of the disease has totally changed. Moreover, in the literature of rötheln the assigned causes of death have been, in my opinion, in some instances, concurrent or accidental maladies which did not result from this disease.

TREATMENT.—In the majority of cases the medicinal treatment should be of the mildest kind or none at all. As death has occurred from bronchitis and pneumonia supervening upon rötheln, the patient should remain in a room of equable temperature, and not be exposed to currents of air. Any local ailment which may arise or any intercurrent disease should of course be promptly treated, since death may occur from them, while the primary disease is not fatal and is even trivial.

CHAPTER IV.

VARIOLA—VARIOLOID.

VARIOLA, or smallpox, is a specific febrile affection, accompanied by a vesiculo-pustular eruption upon the skin. Since the discovery of the protective power of vaccination it has been shorn of much of its terror, but it is still the most loathsome and most dreaded of all the fevers. Two forms of this disease are recognized, depending on the fact whether there have been previous vaccination. If the patient have been vaccinated at some period in his life, the disease, which is rendered milder in consequence, is designated varioloid. If there have been no vaccination, it is called variola or smallpox. Both forms are identical in nature, the one communicating the other; they differ only in gravity.

From accounts still extant—which, however, are vague—this disease appears to have prevailed at a remote period in China and Hindostan. It was carried across the Asiatic continent by caravans engaged in the silk-trade, reaching Europe in the sixth century. Its extension to countries previously free from it has been mainly through commerce and invading armies. It is stated that it reached England in the thirteenth century and Germany and Sweden in the fifteenth century. It was introduced into Mexico by the invading army of Cortez, where for years afterward heaps of skeletons of those who had perished by it were found in shaded localities.

ETIOLOGY.—Different microscopists have observed a microbe in the variolous eruption, designated the micrococcus tetragonus. It bears some resemblance to the sarcina ventriculi, having the appearance of a group of four.

t is readily cultivated in different media, and has an orange-yellow color. Dr. A. Marotta has performed experiments with this microbe which seem to ave the conditions of scientific exactness, and render it highly probable that t is the specific principle of smallpox. He states that he inoculated calves with this microbe of the seventh generation of cultivation, and produced in hem an eruption apparently identical with that of vaccinia, but inoculations f dogs and guinea-pigs were without result.[1] These experiments of Marotta equire verification. Guthmann has found the staphylococcus pyogenes and micrococcus albus in the variolous lymph, but they are often present in maladies entirely distinct from variola, and are therefore not believed to sustain a causal relation to the latter. Although pathologists do not doubt the microbic origin of variola, the microbe which causes it has not yet been clearly ascertained.

Smallpox presents four stages: the initial, or that of invasion; the eruptive; that of desiccation; and, lastly, that of desquamation. It is termed discrete when the pustules remain separated from each other; confluent when they unite. This division is made according to the character of the eruption upon the face and hands. There are parts of the surface, as the abdomen, where the pustules are always discrete, even in the confluent form.

INCUBATIVE PERIOD.—During the last half of the last century inoculation with variolous matter was extensively practised in Great Britain and on the Continent, as it was found that smallpox thus communicated was milder than when received by infection. This operation enabled physicians to determine the period of incubation, which was found to be from eight to eleven days. When variola is communicated through the air the incubative period is somewhat longer—to wit, from twelve to fourteen days.

STAGE OF INVASION.—Smallpox begins abruptly with chilliness. In children of an advanced age there is often, as in the adult, a distinct chill. This is followed by fever and such symptoms as usually accompany a high temperature—to wit, lassitude, anorexia, and thirst. In addition, certain symptoms arise which, though not peculiar to smallpox, are so marked in the commencement of this disease that they possess considerable diagnostic value. These symptoms, which pertain to the nervous system and occur in the initial stage of varioloid as well as variola, are severe frontal headache, pain in the small of the back, and great drowsiness, sometimes with delirium. In many children convulsions occur, preceded and followed by a degree of stupor which is almost as profound as coma. Trousseau suggests the name rachialgia for the pain in the back, since he believes that it is located in or around the spinal cord. This belief is based on the fact which he, as well as other observers has noticed that there is sometimes in connection with this symptom an incomplete paraplegia, indicated by numbness of the legs or even inability to use them, and sometimes more or less paralysis of the bladder. These paraplegic symptoms pass off in a few days. Vomiting is also a common symptom in this stage, and one also of diagnostic value. It occurs at short intervals for twenty-four to thirty-six hours. The same symptom is common in scarlet fever, and not infrequent in measles, but in both these maladies irritability of stomach is much less persistent than in smallpox; vomiting does not occur in normal rubeolous and scarlatinous cases more than once or twice.

The tongue is covered with a moist fur. If the disease is to be discrete, constipation is commonly present in the stage of invasion; if confluent, diarrhœa is a common symptom, continuing till the fourth or fifth day, or even longer. Roseola or erythema sometimes occurs in this stage, and this may lead to error of diagnosis, the disease being mistaken for one of these cutaneous affections or even for scarlet fever. The symptoms in the stage of invasion are usually more violent in confluent than in discrete variola, but there are exceptions.

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[1] Dr. A. Marotta: *Revista Clinica e Therapeutica*, Nov. and Dec., 1886.

STAGE OF ERUPTION.—The eruption commences about the third day, earlier in some cases, later in others. The average duration, therefore, of the first stage is somewhat shorter than in measles, but considerably longer than in scarlet fever. Sydenham has stated—and observations show the truth of the remark—that the shorter the first stage the more severe the disease will prove to be; and, conversely, the longer the period the milder will be its form. Therefore, if the eruption begin on the second day, it will, as a rule, be confluent; if not till the fifth or sixth day, it will be scanty and the disease light.

The eruption commences in minute red spots, somewhat like those of lichen, which gradually enlarge. It is first observed around the lips and upon the neck, then upon the face, scalp, upper part of chest, arms, and finally upon the lower part of the chest, the abdomen, and legs. It is sometimes, especially in young children, first observed in the folds of the skin, as about the genitals or in the groin. If the cuticle be irritated, as by a sinapism, the eruption often appears first upon this part of the surface and in greater abundance than elsewhere. Commencing in a minute reddish point, as stated above, it rapidly enlarges, and soon its central part begins to be indurated and raised. It feels round and hard to the finger, is tender, and its diameter does not ordinarily exceed two lines. This is the papular stage. The papulæ increase and become more elevated, and in twenty-four to forty-eight hours from the commencement of the eruptive stage they become vesicular. On the fifth day of the eruption, or eighth of the disease, the vesicle has attained its full size. Its diameter is then about one-fourth of an inch and its elevation is two or three lines. Its base is circular and indurated, and it is surrounded by a narrow zone of inflammation, indicated by redness and tenderness of the skin. The pock commonly, as it passes from the papular to the vesicular stage, loses its acuminate form, and becomes depressed in the centre, but in most cases mixed with the umbilicated vesicles are some which remain acuminate.

In proportion as the eruption becomes developed in discrete variola and in varioloid, the symptoms which accompanied the stage of invasion abate; the fever, headache, pain in the back, and thirst cease, and the appetite returns. In the confluent form the fever continues with little abatement.

Simultaneously with the eruption upon the skin an eruption also occurs upon the buccal and faucial surfaces, and often upon that of the air-passages. It occurs sometimes, also, upon the conjunctiva, producing dangerous ophthalmia, and even ulceration with loss of sight, and upon the mucous surface of the genital organs. The form which it presents upon mucous surfaces is somewhat different from that upon the skin. There is at first a deposit of fibrin, producing a small, round, grayish spot at the point of eruption—firm, slightly elevated, and covered, if not by the entire mucous membrane, at least by its epithelial layer. Ulceration soon occurs, as in ulcerous stomatitis, and if the patient live the reparative process succeeds, as in simple ulcers. The eruption upon mucous surfaces increases considerably the suffering of the patient, in consequence of the tenderness of the ulcers; and if its seat be the surface of the larynx or trachea, it may be the immediate cause of death, especially in young children, by obstructing respiration.

The cutaneous eruption has been traced to the vesicular stage. On or about the fifth day of the eruptive period, or eighth of smallpox, the vesicles gradually change their character, their contents becoming thicker and turbid. At the same time they increase still more in size and the central depression disappears. This is designated the stage of maturation or of suppuration, though it is known that the turbidity is due chiefly to another substance than pus. The pock, having undergone these changes, is termed the pustule.

In discrete variola and in varioloid the fever returns during the pustular stage, or if the form of the disease be confluent and the fever have continued, it now becomes more intense. The return of fever or its increase is denoted by increased frequency of pulse, elevation of temperature, dryness of skin, anorexia, and thirst. A tendency to constipation remains throughout in varioloid and discrete variola; in the confluent form diarrhœa more frequently occurs, which, if it continue, is an unfavorable prognostic sign.

Other changes occur. The pustules increase somewhat in size and become more globular. Some of them, when most distended, break through friction of the clothes or scratching of the child, and their contents, escaping, add to the loathsomeness of the disease. There is in the pustular stage more or less redness of the surface between the eruptions, and, except in the mildest cases, tumefaction from subcutaneous infiltration occurs. In the confluent form at this period the features are often so swollen that the friends would not recognize the patient. The eyelids may be so œdematous that the eyes are for a time concealed from view. This œdema of the surface is not altogether absent in the vesicular stage, but it increases during the time of maturation, after which it subsides.

STAGE OF DESICCATION.—This immediately succeeds the full development of the pustules. The liquid portion of the contents of the pustules which are broken evaporates, leaving a crust. If there be no rupture, the liquid is absorbed and a scab results, which, though smaller, preserves in a measure the form of the pustule. While the pustule desiccates the surrounding inflammation rapidly abates. The crusts occur first upon the face, and on other parts in the order in which the eruption appeared. The odor from the patient at this time is peculiar. In the confluent form especially it is very offensive, and can be noticed at a distance from the bedside. Rilliet and Barthez call it nauseous and fetid. As desiccation progresses the symptoms, local and general, abate. The pulse and temperature, if the case be favorable, return to the normal; the cough, hoarseness, and thirst disappear, while the appetite returns; the sleep is more tranquil, and the functions generally are more regularly performed.

The last stage is that of DESQUAMATION; it commences between the eleventh and sixteenth days. The scabs, which present a dark or brownish appearance, are successively detached. This period lasts several days; sometimes two or three weeks even elapse before all the crusts separate. In the mean time, the patient gradually recovers his health and former strength. After the fall of the crust the cicatrix underneath presents a reddish appearance. The color gradually fades, and there remains an irregular depression, or pit, of a lighter color than the surrounding surface, and, if there have been a full development of the eruption, disfiguring the patient for life.

Such is the clinical history of variola when it is favorable and its course is regular. The disease is sometimes irregular. In rare instances the eruption occurs almost at the commencement of the attack. The form is then likely to be confluent. There are irregularities also in consequence of diarrhœa, hemorrhages, or other complications. I have known the eruption appear first on the limbs, and last on the trunk and face, and the appearance of the eruption is not always the same. In the anæmic and feeble child it often presents a pale color, with some induration at its base, but without the red areola around it or with this quite indistinct. In rare instances the vesicles have a reddish color, their contents being tinged with blood. This form of variola is designated hemorrhagic. It indicates a profoundly altered state of the blood. The eruption in this form is of small size, and if the pock is broken, blood oozes from it.

I have met one case, perhaps two, of malignant hemorrhagic smallpox, as described by Hebra, among the rare forms of this malady. The second case died so soon that we were undecided whether he had smallpox or scarlatina. A man aged thirty-six years, previously healthy, became suddenly and severely sick in June, 1881, with fever, intense headache and backache, great depression of the vital powers, sleeplessness, and a sensation of sinking or depression in the epigastrium. He had a marked foreboding of coming evil, and begged almost constantly for relief. Within forty-eight hours a heavy and continuous dusky scarlatiniform eruption covered the whole surface, except below the knees, disappearing on pressure; fauces at first but moderately injected. On the following day, the third of his sickness, with a temperature of 104.5°, the efflorescence became a dark red, numerous small extravasations of blood had occurred under the skin, the urine contained blood, and finally it seemed to consist almost entirely of dark blood; a large effusion of blood under the entire conjunctiva of either eye prevented closure of the eyelids, and probably hemorrhages had occurred within the eyes, as the sight was nearly lost. Death took place on the following day. In Hebra's article on smallpox is the description of precisely such cases, but the death of my patient was too early for exact diagnosis.

Varioloid.—The course of varioloid is similar to that of variola, but it is somewhat shorter. It commences with rigors, followed by fever, headache, pain in the back, vomiting, drowsiness, and sometimes delirium, or even convulsions. The symptoms in the stage of invasion are, indeed, the same in character, and often nearly as severe as in variola. With the initial symptoms there is also sometimes a scarlatiniform eruption, so that the disease may at first be mistaken for scarlatina. On the third or fourth day the variolous eruption commences. The number of pocks is commonly few, often not more than twelve to twenty. In the mildest form of varioloid, if the physician be not summoned in the stage of invasion, he may not be called at all, so that the patient passes through the disease in ignorance of its nature. The true character of the malady is not ascertained till others are affected either with variola or varioloid.

The eruption pursues a more rapid course in varioloid than in the unmodified disease. By the fifth or sixth day the pustules are fully developed, though often smaller and less likely to be ruptured than in variola. Often in varioloid the eruption aborts. It remains papular two or three days, and then declines, or it may reach the vesicular stage and decline without pustulation.

The constitutional symptoms in varioloid abate with the commencement of the eruptive stage. The secondary fever is slight or absent.

Such is the usual mild course of varioloid, but not always. If several years have elapsed since the vaccination, its protective power is greatly impaired, and varioloid may then exhibit as severe a form as ordinary smallpox. In some instances it is fatal.

The term varioloid is, as has been stated, applied to cases of variolous disease if there have been previous vaccination. It is also applied by writers to second attacks, whether the first occurred from infection or from variolous inoculation, but such cases are rare.

MODE OF DEATH.—Death in smallpox occurs in several different ways. The most fatal period is the pustular. Feeble children not infrequently die from exhaustion at or about the time that the pustules attain their greatest size. The eruption appears and becomes developed as usual, but there are evidences of weakness in the patient, and suddenly the progress of the vesicle or pustule ceases. It begins to subside and its walls shrivel. There is evidently absorption, in part, of the liquid contents. These phenomena are of the gravest character. Death is the common result, and within twenty-four hours. In other cases death occurs from apnœa. The pock, increasing in size in the larynx and trachea, obstructs inspiration, or there may be the formation of a pseudo-membrane, as in true croup. This is not an unusual mode of death in young children, in whom the calibre of the larynx and trachea is small. Sometimes convulsions and coma occur in the last hours of life. In other cases the stage of desquamation is reached, but convalescence does not occur. The patient each day becomes more anæmic and feeble, and finally death results from failure of the vital powers. Again, after smallpox has run its course purpura hæmorrhagica may be developed. Hemorrhages occur from the gums, throat, nostrils. Blood is vomited, and evacuated in the stools. I have known death to occur in all these ways, but that from purpura is least frequent. Sometimes, as in scarlet fever, death occurs suddenly and unexpectedly in confluent, and even in discrete, variola, when the previous symptoms had apparently been favorable. The patient is overpowered by the intensity of the virus.

Anatomical Characters.—In those who have died of variola without inflammatory or other complication the heart-clots have been found small, dark, and soft. The blood is dark and thin. The vessels of the brain and its membranes are injected, so that numerous red points appear on the cut surface of this organ. The vessels of the lungs and the abdominal organs are congested, while the muscles present a deep-red color. The variolous eruption penetrates more deeply than that of any other exanthematic fever. It has been stated elsewhere that it occurs not only on the skin, but often on the surface of the mouth, fauces, and air-passages. The mucous membrane in these situations is frequently also the seat of catarrhal inflammation, being thickened and softened, and in some parts, as the larynx, a pseudo-membrane is occasionally produced, as in croup.

The eruption very seldom, perhaps never, appears upon the gastro-intestinal surface, but the solitary follicles and patches of Peyer are often enlarged, as in some other zymotic affections. The liver, spleen, and kidneys are commonly congested in those who have died of variola. The spleen especially is increased in volume and softened; the kidneys are enlarged, as from commencing nephritis, and sometimes softened.

The minute structure of the pock is described by Rilliet and Barthez and others. The vesicle is multilocular, consisting of at least five or six compartments with distinct partitions. Its centre is united by fibrous bands to the derm beneath, which union gives rise to the umbilicated appearance. The giving way of these minute bands in the pustular stage occurs when the form changes from the umbilicated to the convex. In the pustular stage also, according to some, a fibrous formation occurs within the pustule; according to others, this substance is of the nature of the epidermis, presenting the appearance of the cuticle when macerated. Mixed with this epidermic or fibrinous formation are pus-cells.

Complications.—There are several different complications of variola. One is salivation. This is common in the adult, but rare in the child. When it occurs in the child it is slight, commencing with or about the time of the eruption, and disappearing in from one to four or five days. Ophthalmia is another complication. Simple conjunctivitis, often quite intense, *may occur in consequence of* pustules developed under the lids. This inflammation subsides without injury to the eye as the primary disease abates. A more serious inflammation occurs at an advanced stage of variola, commencing in or near the desquamative period. This produces more or less chemosis, and sometimes opacity or ulceration of the cornea. A similar inflammation may occur in the ear, giving rise to otorrhœa, and even, in some patients, to rupture of the drum of the ear. Abscesses in the subcutaneous connective tissue have been occasionally observed, especially in the confluent form. Subcutaneous infiltration and feebleness of constitution favor their occurrence. Suppuration within the joints is a somewhat rare complication or sequel, rendering convalescence protracted, if, indeed, the case be not fatal.

M. Béraud has published a memoir to show that orchitis in the male and ovaritis in the female may complicate variola. These inflammations are believed to be accompanied by a small and imperfect variolous eruption upon the tunica vaginalis and the peritoneal covering of the ovary. Trousseau states that he has often met this complication in the male since his attention was called to it. It is mild, and subsides with the disappearance of the eruption. Laryngitis, simple or diphtheritic, bronchitis, pneumonia, pharyngitis, purpuric hemorrhages, gangrene of the mouth or other parts, œdema pulmonum, and œdema glottidis are occasional complications, some of which are frequent, others rare.

PROGNOSIS.—This depends on the age, vigor of system, form of the disease, and the presence or absence of complications. The younger the child the greater the danger. Trousseau says: "Confluent variola, and even discrete variola, are almost always fatal in individuals less than two years old." Above the age of three or four years discrete variola usually ends favorably, but the confluent form is still, as a rule, fatal. Varioloid in the child is a mild disease, terminating favorably in a large proportion of cases. It is milder at this age than in the adult, on account of the more recent period of vaccination. If varioloid be severe and the eruption abundant in a child who has been vaccinated, it is probable that the vaccination was spurious.

It is not necessary, from what has been said, to specify the favorable prognostic signs. The unfavorable prognostics are—great violence of the initial symptoms; early appearance of the eruption; an abundant eruption, especially if pale and without swelling of the surface; rapid decline of the eruption in the vesicular or pustular stage; hemorrhagic eruption or hemorrhages from the surfaces; fever continuing after the appearance of the eruption; diarrhœa persisting beyond the third or fourth day; delirium or great drowsiness; a frequent and feeble pulse; and, finally, obstructed respiration—if slow, indicating a pseudo-membrane or variolous eruption in the larynx or trachea; if rapid, indicating bronchitis or pneumonia.

DIAGNOSIS.—The diagnosis cannot be made with certainty prior to the eruptive stage. If, however, smallpox be prevalent, if the patient have not been vaccinated, and the symptoms which pertain to the period of invasion be present, as headache, pain in small of back, repeated vomiting, drowsiness, and perhaps convulsions, there is ground for the gravest suspicion. If in addition to these symptoms reddish points begin to appear on the second or third day, the diagnosis may be made with confidence. At this early period, even before there is any distinct cutaneous eruption, ash-colored spots may sometimes be observed on the buccal or faucial surface, the commencement of the variolous eruption: these possess considerable diagnostic value.

The scarlatiniform efflorescence in the first stage of variola sometimes leads to the belief that the disease is scarlet fever. The absence of the pharyngitis and the appearance of the variolous eruption soon after the efflorescence correct the diagnosis. Smallpox has, in the beginning of the eruptive period, sometimes been mistaken for measles. The points involved in the differential diagnosis have been presented in treating of that disease. After the development of the eruption it may be mistaken for varicella. The eruption of varicella is, however, preceded by symptoms which are milder and of shorter duration, and its appearance is different. It is irregular, instead of round, is not umbilicated, and it does not have the round, inflamed, and indurated base which characterizes the variolous eruption. The eruption of ecthyma is sometimes umbilicated, but the symptoms of ecthyma and variola and the progress of the eruptions in the two diseases are very different.

TREATMENT.—Smallpox, like the other essential fevers, is self-limited, and therefore the constitutional treatment should be sustaining and palliative. In the first stages of the disease the diet should be simple; gentle laxatives and refrigerant drinks are required if there be much febrile excitement. Lemonade is a grateful drink, and may be given in moderate quantity. Spiritus mindereri in carbonic-acid water may be allowed. As the disease advances more nutritious food should be recommended, and in severe cases carbonate of ammonium, and even alcoholic stimulants, are required.

As confluent smallpox is nearly always, and the discrete form often, fatal in infancy, the physician should carefully watch the progress of the case in the infant. By judicious treatment some in this period of life may be saved who otherwise would perish. In the infant depressing measures should be avoided. A laxative may be given at first if there be much fever and the bowels are constipated; but the diet should be nutritious, and many soon require tonics and stimulants. If the pulse become more frequent and feeble, or if, with frequency of the pulse, the face and extremities become cool, or in the vesicular or pustular stage the eruption suddenly subside, alcoholic stimulants must be immediately employed or the patient dies.

Such is an outline of the constitutional treatment required in smallpox. Sydenham inculcated a mode of treatment which experience has shown to be injurious in infancy and childhood. He had observed that the severity of the disease was ordinarily proportionate to the amount of eruption, and concluded from this fact that measures which retarded the development of the eruption were salutary: cold drinks, a cold apartment, scanty covering of the body, cathartics that caused derivation of the blood from the surface, even sometimes the abstraction of blood, were considered, according to Sydenham's theory, to be useful as means of preventing full development of the eruption.

Sydenham's treatment, however appropriate it might sometimes be in case of robust adults, is unsuitable for children, because they do not, as a rule, tolerate in this disease measures which reduce the strength. Moreover, smallpox is rendered more dangerous by what Rilliet and Barthez designate perturbating treatment—treatment which renders it abnormal. The regular appearance and development of the eruption are requisite in order that the case may progress favorably. On the other hand, the opposite plan of treatment, which families, if left to themselves, frequently adopt—to wit, the employment of measures to promote perspiration, as hot drinks and confinement in a heated room—is also injurious.

The patient should be kept in a temperature such as he has been accustomed to and such as is agreeable to him—a temperature at 66° to 70°; his diet should be simple and nutritious; laxative medicine should only be given to procure the natural evacuations. In smallpox, as in all infectious diseases, free ventilation of the apartment is required. The room should be dark, for a strong light perhaps increases the pitting.

While the general eruption should not, as a rule, be interfered with, it is proper to endeavor to diminish, so far as possible, the size of the pocks on parts exposed to view, so as to prevent disfigurement. Professor Flint, in his *Treatise on the Practice of Medicine*, has published an excellent summary of the various measures which have been recommended for accomplishing this end. First: The opening and breaking up of the vesicle by means of a fine needle. This is tedious practice in confluent variola, but it can readily be performed in the discrete form—at least as regards the vesicles upon the face. This treatment was proposed by Rayer, and it is recommended by many who have tried it. Secondly: After the evacuation of the liquid the cauterization of the vesicle by a pointed stick of nitrate of silver. Rilliet and Barthez say, in reference to this mode of treatment, "Individual cauterization of the pustules is, on the other hand, an almost infallible means of causing them to abort. To be successful, it is necessary to penetrate into the interior of the pustule with a pointed crayon of nitrate of silver in order to cauterize the derm. . . . . It is only the first or second day of the eruption that it (cauterization) has certain success; nevertheless, we have often seen it succeed the third or the fourth day, or even the fifth." Thirdly: The application of tincture of iodine once or twice daily over the eruption when in the papular stage. Some writers who have employed iodine state that it does not prevent pitting, but diminishes it. Its favorable effects are produced by coagulating the contents of the papule. Fourthly: The exclusion of light and air by means of a plaster. A mixture containing tannate of iron has been employed for this purpose in one of our hospitals. This produces a black mask. Light and air may also be excluded by smearing the face with sweet oil and dusting twice daily upon the oiled surface a powder containing equal parts of subnitrate of bismuth and prepared chalk. Fifthly. The application of mild mercurial ointment upon the face or other parts of the surface where it is desirable to render the eruption abortive. This mode of treatment does diminish the size of the vesicles and the pitting, but I should not recommend it for children. I have known in the adult severe mercurialization from its employment for four or five days, and, though young children do not exhibit so readily the effects of mercury, the use of the ointment, unless for a very limited period, increases, in my opinion, their feebleness and diminishes the chance of their recovery. Calamine made into a paste with sweet oil is said to be equally effectual with mercurial ointment, and it produces no constitutional effect. Its effect is obviously similar to that of the bismuth and chalk employed with sweet oil as stated above. Also, I have employed pulverized charcoal made into a thin paste with sweet oil or glycerin, and applied daily or twice daily to the face. It effectually excludes the light, and the result appeared to be good as regards pitting, but it is a disagreeable application. Curschmann recommends as preferable to any of these methods the use of iced compresses to the face and hands. The pain, redness, and swelling are diminished by their use, but without change in the copiousness of the eruption (*Ziemssen's Encyclop.*). If fissures or excoriations occur, an application may be made of oxide or carbonate of zinc in glycerin, one drachm to the ounce.

Dr. Tomkyns of the Fever Hospital, Manchester, England, states that he has used with good results the following mixture, applied from time to time over the surface:

℞. Glycerini, ℥ss;
Tinc. iodini, ʒij;
Sol. amyli, Oss. Misce.

The intense itching and the fetor are, according to my observations, best relieved by frequent bathing with the following wash:

R. Acidi carbolic., ℥j;
Tinc. camphor., ℥ij;
Aquæ, Oj. Misce.

Shake bottle before using.

The prevention of smallpox, so far as practicable, is one of the important incidental duties of the physician. Isolation of the patient and precautions in reference to his clothes and bedding are imperatively required, so great is the contagiousness of this disease. The only certain means of prevention is vaccination, and providentially the incubative period of the vaccine disease is less than that of variola. Therefore, smallpox may be prevented after the virus is received in the system by timely and successful vaccination. Vaccination, at any period between the time of exposure and the commencement of the symptoms of invasion, will either prevent the occurrence of smallpox or modify it. If the symptoms of invasion have already commenced, it is uncertain whether it produces any modifying effect.

Variola is so very contagious that there is danger that the physician and attendants may communicate it through their persons or clothing. The virus adheres tenaciously to objects, and may be conveyed by them long distances. Therefore the room occupied by the patient should contain no unnecessary articles, as books or writing material, and the physician attending a case should bathe and change his clothing before going elsewhere. A disinfectant should also be constantly used in the room, as the following, which I have recommended in the treatment of diphtheria and scarlet fever:

℞. Ol. eucalypti,
Acidi carbolic., *āā.* ℥j;
Spts. terebinth., ℥viij. Misce.

Two teaspoonfuls in a quart of water, placed in a tin vessel, shallow and with broad surface, and maintained in a state of constant simmering.

CHAPTER V.

VACCINIA.

Vaccinia is a mild eruptive disease which occasionally occurs among cattle and has been propagated from them to man. It is characterized by the appearance upon the surface of one or more papules, which soon become vesicular and then pustular. It is communicable by contact, but, unlike the other eruptive fevers, it is not contagious through the air. It is inoculable, both by the liquid contained in the vesicle, which is designated vaccine lymph, and by the scab which results from the desiccation of the pustule.

To Gloucestershire, England, the honor belongs of discovering and utilizing the fact that vaccinia, a mild and comparatively harmless disease, is transmissible from the cow to man, and that it affords protection from smallpox. It appears that a vague opinion prevailed among the farmers of this dairying section that a disease which has since been designated vaccinia was occasionally received from the cow in milking, the virus passing from a pustule on the teat to a sore or chap on the hand of the milker, and that those who thus contracted the disease received immunity from smallpox. As usually happens with important discoveries, so slow of apprehension is the human intellect, these people, to whom Providence had revealed a most important fact, were blind to its real value. Finally, in the year 1724, Benjamin Jesty, whom the world has not sufficiently honored, "an honest and upright man," according to his epitaph, a farmer of Gloucestershire, had the courage to vaccinate his wife and two children. His excellent moral character did not shield him. He was regarded by his neighbors as an inhuman brute, who had performed an experiment on his own family the tendency of which might be to transform them into beasts with horns.

This first essay in vaccination appears to have been entirely successful, but the prejudice against the operation continued. A fifth of a century passed, during which there was no extension of the benefits of this great discovery. At last, toward the close of the last century, Dr. Edward Jenner, a physician of Gloucestershire, an inoculator of his district, began to investigate this disease of the cow, about which little was known, and the grounds for the belief that it afforded protection from smallpox. Fortunately for the world, Jenner had been educated under John Hunter, and had learned from his great master to study nature rather than books—to be guided by experience and observation rather than by the dogmas of his predecessors or of the schools.

Jenner performed his first vaccination on the 14th of May, 1796, twenty-two years after Benjamin Jesty had lost his good name among his neighbors by vaccinating his own family. The popularizing of vaccination, mainly through Jenner's perseverance, affords one of the most interesting and instructive chapters in the history of medical science—how he went to London full of the importance of the discovery, and was there advised by his medical friends to desist from his wild schemes, lest he should injure the reputation which he had gained from a creditable paper on the habits of the cuckoo; how he was finally allowed to vaccinate in hospital wards, and gained some adherents to the new faith among the leading physicians of the metropolis, and, finally, how, as the claims of vaccination began to be recognized at the close of the last century and commencement of the present, a most acrimonious discussion arose which filled all the medical journals of that period. The opponents of vaccination resorted to every device to prevent the acceptance of Jenner's views. They attempted to prejudice the people against them by specious arguments, by ridicule, and even by caricatures. One of the leading journals contained the picture of a cow covered with sores and devouring children, and it was urged that vaccination was a bestial operation, degrading man to the level of the brute. But the truth had gained a firm hold and the practice of vaccination extended.

The discovery of vaccinia and of its protective power cannot be too highly appreciated. It has probably done more to relieve human suffering than any other discovery of the last one hundred years, unless we except that of anæsthetics, and more to save human life than any other instrumentality of a purely physical kind.

The fact was established in the time of Jenner that the virus of smallpox inoculated in the cow produces vaccinia, which in its propagation back to man never returns to its original form, but always remained vaccinia. Moreover, Jenner believed that the disease known in the horse as the grease was identical in nature with vaccinia in the cow. He failed, however, in his experiment to communicate vaccinia from the horse, but other experiments have been more successful. In 1801 a Dr. Loy of the county of York, England, met two cases of vaccinia in persons who had taken care of a horse affected with the grease, and from the lymph which he obtained was able to produce vaccinia in the cow. In 1805, Viborg, a Danish veterinary surgeon, after many failures, succeeded also in communicating vaccinia to the cow by means of the virus taken from a horse.

From this time little light was thrown on this subject till within the last twenty years. Although Loy and Viborg, and perhaps a few others, had recorded their success, other experimenters had failed to communicate vaccinia from the horse. In the absence of additional cases the profession began to question whether there might not have been some error in the observations of the gentlemen whose names I have mentioned, and whether a disease identical with vaccinia, or a disease which may communicate vaccinia to the cow or to man, occurs in the horse.

Observations confirmatory of those of Loy and Viborg were at length, however, made, which must be regarded as conclusive. In 1856, in the department of L'Eure-et-Loir, France, M. Pichot was consulted by a boy who had on the back of his hands vaccine pustules which had apparently reached the eighth or ninth day. He had not taken care of nor been in contact with a cow, but had a few days before taken care of a horse affected with the grease. Vaccination was performed by means of the lymph taken from the pustules, and genuine vaccinia was produced.

Again, in 1860 an epidemic prevailed among the horses in Riemes and Toulouse, France. A mare sickened with the disease, and there was swelling of the hough, with discharge of sanious matter. M. Delafosse vaccinated two cows with this matter and communicated genuine vaccinia. This epidemic was believed by the veterinary surgeons to be an eruptive fever, differing in its nature somewhat from the disease or diseases which have ordinarily been designated the grease. It has been conjectured that two or more distinct affections of the horse have the same appellation—one of which, it is now admitted, is identical with vaccinia of the cow and may communicate it; and the reason why so many experimenters have failed to vaccinate the cow from the horse is that they have used the virus of the wrong disease, or have taken virus from horses which had been affected with true disease, but from ulcers which had lost their specific character.

Prior to the time of Jenner variolous inoculation was practised in most civilized countries, since variola produced in this way was found to be milder than when arising from infection. This practice is now obsolete, forbidden in some places by legislative enactments. It is superseded by vaccination. Vaccination, or the introduction of vaccine lymph into the system, is quickly and conveniently performed by scarifying with a lancet and rubbing into the incisions the lymph or a little of the scab pulverized and dissolved in a drop of cold water. It may also be performed by scraping off the epidermis with the edge of the instrument till the blood begins to ooze; and also, though with less certainty of success, by puncturing the skin with the point of the lancet or by an instrument called the vaccinator. The scab should never be employed when it is possible to obtain pure lymph, since it contains animal matter apart from the virus, and may be the medium through which other diseases may be communicated. Besides, it is much less active than pure lymph.

If the child have a vascular nævus, this may be selected as the point of vaccination. Unless of large size, it can usually be cured by the inflammation which vaccinia produces. Statistics collected by Simon, as well as Marson, show that in those who contract varioloid the larger the number of vaccine cicatrices the milder the disease and the less the proportionate number of deaths. In Simon's statistics of those who stated that they had been vaccinated, but who presented no cicatrix, 21¾ per cent. died; of those who had one cicatrix, 7½ per cent. died; of those who had two, 4¼ per cent. died; of those who had three, 1¾ per cent. died; while of those who had four or more cicatrices, only ¾ per cent. died. These statistics would seem to indicate the propriety of vaccinating in several places. But, so far as appears, when two or more cicatrices were observed the patients may have been vaccinated at different times, at intervals of several years; and if so the inference would not follow that more complete protection is produced by vaccinating in several places than in one. Moreover, if vaccination be performed in the usual manner by several incisions on the arm, and the virus be fresh and active, usually two or more distinct vesicles arise, which unite in their development and probably protect the system as much as if they were separated by a wider space.

APPEARANCES; SYMPTOMS.—In genuine vaccination no effect is observed, except the slight inflammation due to the operation, till the close of the third day. Then the specific inflammation commences. This is indicated by a small red point, at first scarcely visible, indurated and slightly elevated, as determined by the touch rather than by the eye. This increases, and on the fifth day the cuticle over the inflamed part begins to be raised by a transparent and thin liquid. The vesicle increases in diameter, and by the sixth day presents an umbilicated appearance and is surrounded by a faint and narrow red zone. At the close of the eighth day the vesicle is fully developed. Its size varies considerably. It is usually from a sixth to a third of an inch in diameter, and oval or circular. If the vaccination have been performed by incisions, the size of the matured vesicle may be considerably larger and its shape irregular, in consequence of the union of two or more vesicles. The eruption now presents a whitish or pearl-colored appearance, due to the whiteness of the cuticle and the transparence of the liquid underneath. If the vaccination be performed by incisions, it is not unusual to observe over the centre of the vesicle, and adhering to it, a small yellowish scab, which has resulted from the scarification and which contains none of the virus.

The vaccine vesicle, like that of variola, consists of compartments, commonly eight or ten, with complete partitions, so that there is no intercommunication. On the ninth day the inflamed areola becomes more distinct and its diameter rapidly increases. Its color is deep red, its temperature is considerably elevated, and it is accompanied by more or less induration of the subcutaneous tissue, and it is tender to the touch. On the tenth day the pock has reached its full development. The areola extends from one to two inches away from the vesicle, becoming fainter at its outer circumference and gradually disappearing in the healthy skin. The shape of the outer circumference of the areola is irregular, projecting farther at one point than another, though its general form is circular.

On the tenth day, when the inflammation has reached its maximum, the heat, itching, and tenderness in and around the pock are such that the child is often feverish and restless. Occasionally the glands of the axilla become swollen and tender. In other cases, in which there is but a moderate amount of inflammation, the constitutional disturbance is slight.

At the close of the tenth day or on the eleventh the inflammation begins to decline; the areola becomes narrower and then disappears; the induration and tenderness abate; and with this change the pustule desiccates, its liquid is absorbed, and there results a brownish or dark mahogany-colored scab, which is detached, ordinarily, between the fourteenth and twenty-first days. The cicatrix, at first reddish like all recent cicatrices, gradually becomes paler, and remains whiter than the surrounding integument. It presents several minute depressions or pits, which indicate the genuineness of the vaccination.

The theory that smallpox becomes vaccinia by passing through the heifer, as we have given it above, has for many years been undisputed. But recently the theory has been promulgated that vaccinia and variola, instead of being forms of the same disease, are essentially distinct—that when the heifer is inoculated with the virus of smallpox, the disease which is produced is a modified smallpox, but not vaccinia, which occurs as a spontaneous disease among cattle. It may be that the old theory, which no one doubted until recently, is wrong, but that vaccination prevents smallpox just as a mild attack of scarlet fever prevents a severe attack of the same disease, shows, in my opinion, a close relationship between vaccinia and the severe malady which it prevents. We wait for more conclusive facts in support of the new theory before accepting it.

Anomalies, Complications, and Sequels. — The vesicle is often broken accidentally or by the nails of the child. If the top of the vesicle be destroyed or most of the compartments be opened, the inflammation is commonly increased, considerable suppuration occurs, and there results a large, irregular, yellowish scab consisting of the virus mixed with desiccated pus. The scab is entirely unreliable and unfit for the purpose of vaccination, though the protective power of the disease is not diminished by injury of the vesicle even if it be totally destroyed. The cicatrix which results from extensive injury to the vesicle is usually large and without the indented points which characterize the normal cicatrix.

In rare cases, when the inflammation which surrounds the vesicle is intense and deep seated, suppuration occurs in the subjacent connective tissue, giving rise to an abscess. This abscess is commonly of small size, but it increases the fretfulness and constitutional disturbance which attend vaccinia. This subcutaneous suppuration occurs most frequently in those who have a scrofulous or vitiated state of system. Inflammation of the lymphatic glands of the axilla I have spoken of as not infrequent in vaccinia. This sometimes proceeds to suppuration, producing an unpleasant though not serious complication.

It sometimes happens that vesicles appear in other parts besides the points where the virus was inserted. These supernumerary vesicles commonly occur where the cuticle has been removed by scalds or injuries.

Trousseau relates the case of an infant whom he had vaccinated. On the eleventh day he was astonished to find twenty-seven vaccine pustules on the face, trunk, and limbs. This infant had, however, before the vaccination a simple non-specific eruption over the whole body, and it was believed that it had produced these vaccinations by transferring the lymph with its nails to the various parts where the cuticle was denuded.

It is not unusual, also, to observe minute papules appearing on parts of the surface simultaneously with or soon after the vesicle, and in a few days declining. These seem to be abortive vaccine eruptions.

One of the most serious complications is erysipelas. This may occur directly from the operation or from the inflammation caused by the vesicle when the virus possesses no deleterious property; and, again, it may result from some unknown element in the virus. It may occur immediately after the operation, when it commonly prevents the working of the virus, or during the vesicular or pustular stage, or, again, after desiccation and separation of the scab. I have observed it at all these periods.

Erysipelas, occurring as a complication of vaccinia, is invariably referred by the friends to the virus employed, and the physician who has had the misfortune to vaccinate is often unjustly blamed. In many of these cases there is a strong predisposition to erysipelas at the time of the vaccination, and the operation or the inflammation which accompanies the normal development of the vesicle serves simply as an exciting cause. Erysipelas would occur as soon from a non-specific sore; indeed, we not infrequently are called to cases of this disease in young children which commence from non-specific sores upon the genitals or on one of the limbs. That the fault is not in the virus employed is evident from the fact that other children, vaccinated with the same, have simple uncomplicated vaccinia.

Sometimes, on the other hand, the cause of erysipelas, whatever it may be, exists in the virus. (For further facts in reference to this subject the reader is referred to our remarks on erysipelas.)

The fact is established by many observations that syphilis is communicable by vaccination. The symptoms of it may not appear till vaccinia has terminated or for a little time subsequently, but it then constitutes a very serious sequel. A physician of this city, well known in this community as skilful in the diagnosis and treatment of skin diseases, and therefore not likely to be mistaken as regards the nature of the diseases, states that he communicated syphilis to two infants by vaccinating with the same scab. Both had the characteristic syphilitic eruption. In January, 1868, an infant was brought to Prof. Alonzo Clark's clinique in this city having syphilitic rupia, which in the opinion of the physicians present was undoubtedly the result of vaccination.

Trousseau relates the case of a young woman eighteen years old who was vaccinated with virus taken from an infant apparently in perfect health. The vaccination was unsuccessful, but twenty-three days subsequently his attention was called to an eruption which had appeared in two places on the woman's arm corresponding with the points where the virus had been inserted. The eruption was that of ecthyma, which by the next examination, which was five days subsequently, had been transformed into rupia. The axillary lymphatic glands were tumefied and indolent; finally roseola appeared, which removed all doubts as to the syphilitic character of the disease. There was syphilitic infection, which first manifested itself in the points where vaccination had been performed (*Article de la Vaccine*). It is not ascertained in Professor Clark's case, nor is it stated in Trousseau's, whether the lymph or scab was employed for vaccination. There can be little doubt that the pure lymph never communicates anything but vaccinia, and if by vaccination any other disease be imparted, a little blood has mingled with the lymph or the scab has been employed.

The vesicle in genuine vaccinia is sometimes very small, not having a diameter of more than two lines. Occasionally the development of the vesicle is retarded. It does not appear till two or three days later than the usual time, or even a longer period.

Vaccinia is modified by certain diseases. It is arrested by measles and scarlet fever, pursuing its course after the subsidence of the exanthem. On the other hand, it sometimes modifies the paroxysmal cough of pertussis, but only during the time when the pock is maturing. Eczematous eruptions occasionally occur after vaccinia, as they often do after the other eruptive fevers, or if already present they may be aggravated.

SUBSEQUENT VACCINATIONS.

A second vaccination, performed prior to the ninth day after the first vaccination, is successful. A genuine vaccine eruption results, which is smaller the more advanced the primary disease. This second eruption overtakes the first. On the ninth day the susceptibility to vaccinia is, in most cases, lost, so that vaccination performed on the tenth or subsequent days is unsuccessful.

As a rule, an acute contagious disease occurs only once in the same individual. Vaccinia is an exception. In most people, after a few years it can be produced a second time, and cases of a third or fourth successful vaccination at intervals of a few years are not uncommon. Now, subsequent cases of vaccinia differ from the first, which has been described above. The period of incubation is shorter, and the vesicular, pustular, and desiccative stages succeed each other more rapidly, so that the whole period of the disease is less. The variation from the appearance and course of the first vesicle is proportionate to the degree of protection which the first vaccination still affords both as regards smallpox and vaccinia. If several years have elapsed since the first vaccination, and the protective power which it affords is nearly lost, the second vaccinia differs but little from the first. If, on the other hand, the first vaccination still affords nearly complete protection, the result of the second is slight; the eruption is insignificant, lacking the characteristic appearance of the vaccine vesicle, resembling a common sore, and disappearing within a week. It is not accompanied by the inflamed areola or any appreciable constitutional disturbance.

Vaccination often produces no result. This is sometimes due to the fact that the lymph or scab employed is useless. It has spoiled by keeping or never has been good. In other cases it is due to a lack of susceptibility in the person. Some take vaccinia with difficulty and only after several vaccinations; just as children, though fully exposed, often fail to take measles or scarlet fever, on account of a condition of the system which prevents the reception of the virus or antagonizes and controls its action. In some instances after vaccination an eruption is produced which may or may not be genuine, but it immediately becomes purulent and is soon broken. A large yellow, uneven scab results, having none of the appearance and containing little or none of the vaccine virus. This scab, as well as the liquid matter which preceded the formation of the scab, is utterly useless for the purpose of vaccination, and if so employed will probably cause a sore from its irritating effect, but not of a specific character. If, in place of the true vaccine vesicle, the eruption presents the appearance which I have described—namely, that of a pustule, soon breaking and forming a large irregular, yellowish scab—the vaccinia (if it be correct so to designate it) must be considered spurious. A sore has been produced by the animal matter which was employed in the vaccination along with the virus, which has modified the action of the virus, and probably has rendered it useless as a means of protection; or there may have been no virus inserted with this animal matter. The physician should in such cases insist on a second vaccination.

Cases like the above are of frequent occurrence, and the parents of the child are often satisfied with the result. They see an eruption following vaccination, accompanied by considerable inflammation and leaving a cicatrix. Unless undeceived by the physician, they probably remain in the belief of the child's security until, perhaps, it takes smallpox. Such cases obviously tend to diminish the confidence which the public should have in vaccination as a means of protection from smallpox, and on account of their frequent occurrence it is important in every case that the physician should see the result of his vaccination. It has been proposed, as a means of determining the genuineness of vaccinia, to revaccinate when the eruption begins, and if the first be genuine the second will overtake it. This is called Brice's test, but it is not necessary, since the physician, familiar with the appearance of the true vesicle, can determine at once its genuineness by the sight.

Protection from Vaccination—Revaccination.

It was believed by the early advocates of vaccination that the general performance of this operation would soon eradicate smallpox from the community, so that it would be interesting only to the medical historian as a scourge of past ages. This result, however, is only partially achieved. As a rule, the greater the benefit of any measure designed to ameliorate the condition of mankind, the greater and more numerous are the obstacles which diminish its effectiveness. Science is full of examples of this. Fortunately, these obstacles as regards vaccination are not such as to impair the confidence of physicians in its protective power, and it is not too much to expect that this simple operation will yet be the means of rendering smallpox a disease almost unknown, unless in its modified form.

Vaccination should be performed in the first year of life. In rural districts, where there is little danger of exposure to smallpox, it may deferred till the age of ten or twelve months. In the city, on the other hand, where there is constant intercourse of people and where contagious diseases are often contracted in ignorance of the time and place of exposure, an earlier vaccination is advisable. Some physicians recommend performance of the operation as early as the age of four or six weeks. The objection to this is that if erysipelas occur so young an infant is likely to perish from it, whereas an infant three or four months old ordinarily recovers. For this reason I believe that the most suitable age is about four months for the city infant in ordinary times; but if smallpox be epidemic, vaccination should be performed at an earlier age. I have vaccinated even the new-born infant when smallpox had broken out in adjoining apartments.

Vaccinia usually extinguishes, for a time, the susceptibility to smallpox. According to Mr. Gintrac, varioloid does not occur within two years in those who have been vaccinated. It may, however, in exceptional instances, occur in a mild form within a few months after vaccination. The protection afforded by vaccination gradually diminishes by time, but it does not probably, as a rule, entirely cease. Varioloid, however, occurring thirty or forty years after a successful vaccination is likely to be severe, and it may even be fatal, showing that it has been but slightly modified. In other cases, even after so long an interval, the symptoms present a degree of mildness which indicates that the protective power of the vaccination is not entirely lost.

If a second vaccination be practised soon after the scab from the first vaccination has fallen, it will usually produce no result, but in other cases it gives rise to a little redness, swelling, and induration, which show that vaccinia has been reproduced, though in a very mild and insignificant form. It is probable that in these cases varioloid might also occur by exposure, though with a mildness corresponding with that of the vaccinia. The longer the period after the first vaccination, the greater the number of those in whom a second vaccination is effective, and, as has already been stated, the greater also the liability to the variolous disease until the system is protected by a second vaccination. A second vaccination should be performed about the sixth or eighth year, and a third between the fifteenth and twentieth years. If smallpox be epidemic, it is proper to vaccinate all who have not been vaccinated within three or four years.

SELECTION OF VIRUS.

The lymph is preferable to the scab for vaccination, provided that it can be obtained fresh. The scab is more easily preserved, and therefore, if the lymph and the scab be old, the latter is to be preferred. The lymph should be taken on the fifth day if the vesicle be sufficiently developed. It may also be taken on the sixth, seventh, or even eighth day, provided that the areola has not formed. The lymph of the fifth day acts with greater energy, though that of the sixth or seventh day is not much inferior. Lymph obtained after the formation of the areola is less efficient, though it may communicate the genuine disease.

There is no mode of vaccination so reliable as the use of lymph taken directly from the arm and immediately inserted—the arm-to-arm vaccination.

Lymph can be preserved for a few days on a flattened surface of whalebone or the segment of a quill, and if employed within a week it will usually communicate vaccinia. Lymph may be preserved a longer period between two surfaces of glass, but the best way of preserving it is in capillary glass tubes. The end of the tube is placed within the vesicle, and the lymph ascends by capillary attraction. When a sufficient quantity is received, the ends are sealed by holding them for a moment in a flame. Care is requisite in doing this so as not to heat the lymph, as it is spoiled by a temperature much above that of the body. When the lymph is used, the ends of the tube are broken, and by blowing gently through it a sufficient quantity is received on the point of a lancet.

If the scab be genuine, it presents a dark-brown or mahogany color, and has a circular, oval, or at least a rounded form; it is firm or compact, and has a lustre. Soft, yellowish, and irregular scabs are not genuine, and those of a dull appearance or without lustre have usually spoiled in the keeping. The scab is best preserved in soft beeswax, which excludes the air, and it should be kept in a cool place. It is the belief of many that the vaccine virus gradually becomes weaker by passing successively through the human system (Condie, *American Journal of the Medical Sciences*, April, 1865), and that therefore different specimens of virus work with different energy according to the degree of removal from the cow. To what extent this view is correct is not fully ascertained, but certainly if the virus employed continue to produce a small vesicle attended only by a little inflammation, there is reason to believe that the protection which it imparts is less than that from virus which works with greater energy, and it should be exchanged for such. In New York we are able to obtain at any time lymph directly from the heifer. It has never passed through human blood, for the original lymph came from cattle in one of the provinces of France, where vaccinia was prevailing epidemically. The popular objection to vaccination is obviated by the use of this lymph, but it works with great energy, producing a large pock and a sore which is often a month in healing. I have found it very reliable, and prefer to use it in ordinary cases.

CHAPTER VI.

VARICELLA.

VARICELLA, chickenpox, or swinepox is the shortest and mildest of the eruptive fevers. It is highly contagious, so that few children escape who are exposed to it. Its period of incubation is from fifteen to seventeen days. Hutchinson (*Brit. Med. Jour.*, 1881) and Le Gendre (*L'Concours Med.*, 1887) state that varicella is inoculable, but some years ago inoculations which I performed with the lymph of the varicellar vesicle were without result. It attacks the same individual but once, and it occurs as an epidemic. It has been thought by some to prevail most immediately before, during, or after epidemics of smallpox, and it has been conjectured that it is a modified form of variola, and hence its name, which signifies little variola. This idea is, however, entertained by few, and it is opposed by the following facts: Varicella may occur after variola or variola after varicella without any modification, and the two diseases are very dissimilar as regards gravity of symptoms and duration. The variolous disease, whether smallpox or varioloid, often occurs in the adult; varicella, on the other hand, is a disease of infancy and childhood. I have seen one adult case, which I recall to mind, and Professor Flint states that he has also observed it, but its occurrence at this period of life is rare. Senator relates a case that occurred at the age of eleven days. In 584 cases observed by Baader the ages were as follows:

Cases.	Age.
382	1– 5 years.
191	6–10 "
7	11–15 "
2	16–20 "
2	21–40 "

Moreover, varicella and variola have been known to occur simultaneously in the same individual. Such a case was reported by M. Delpech in a memoir published in 1845.

SYMPTOMS.—Varicella usually commences with such symptoms as usher in ordinary mild febrile attacks—namely, headache, languor, chilliness, and sometimes aching in the back and limbs. Fever supervenes, which is usually moderate, the pulse rising perhaps to 100 or 112, and the thermometer showing an increase of temperature, but less than occurs in the other eruptive fevers. These symptoms which precede the eruption are sometimes absent or are so mild as to escape notice. The fever usually ceases on the second day, but it may return on the following night. The appetite is rarely lost, and most children continue more or less at their amusements.

When the above symptoms have continued about twenty-four hours the eruption appears first over the trunk, and soon afterward over the face and limbs. It consists of minute disseminated papules which become vesicular in the course of a few hours. The occurrence of the vesicular stage is nearly simultaneous on all parts of the surface, and commonly fresh vesicles appear during the first three or four days. The vesicles lack the hard, indurated base of the variolous eruption, though they are sometimes surrounded by a faint zone of redness. They differ also from the variolous eruption in the absence of umbilication and in irregularity of shape. Some are small and acuminate, some hemispherical and of medium size, and others oval or elongated and of large size. The inflammation is quite superficial, not involving the subcutaneous tissue and scarcely affecting the deepest layer of the skin.

The vesicles vary in size from the diameter of half a line to that of even three lines. They occasionally give rise to slight itching. On the second day of the eruption or third day of the disease they are still fully developed, their liquid contents being nearly transparent. At the close of this day the liquid begins to be somewhat cloudy and its absorption commences. On the fourth day of the disease desiccation progresses rapidly, and by the fifth the liquid has for the most part disappeared, and a scab results, small, thin, and of a yellowish-brown color. The scabs are soon detached, the redness which indicated their seat disappears, the epiderm which had been raised and removed by the eruption is reproduced in its normal state, and in a few days all evidence of varicella is effaced. A cicatrix occasionally results, but it is due not to the simple varicellar eruption, but to a sore produced from the eruption by the scratching of the child.

The number of vesicles varies considerably in different cases. They are never, so far as I have observed, confluent; but they are sometimes so abundant in young children that if the disease were variola it would be called severe discrete. They occur also on the buccal and faucial surfaces, where they soon break, forming small ulcers. The duration of the disease from the first symptoms until the disappearance of the crusts is eight or ten days.

Mr. J. Hutchinson of London has described a rare form of varicella in which the eruption becomes gangrenous. It occurs most frequently in feeble, ill-conditioned children, but sometimes in those who are well nourished. Only a portion of the vesicles become gangrenous. Where the gangrene occurs a deep and unhealthy ulcer forms underneath the scab, which does not heal or heals slowly. This rare form of varicella is very fatal, death sometimes occurring from pyæmia and secondary abscesses. Crocker states (*London Lancet*, May 30, 1885) that the gangrene sometimes occurs upon a part of the surface which is not the seat of the eruption.

Complications; Sequelæ.—Complicating maladies which sometimes supervene in varicella do not, for the most part, occur in consequence of this disease, but are independent of it. Erysipelas has in rare instances supervened on the varicellar eruption, but its occurrence is attributable to the ordinary causes of this disease, rather than to varicella. Various sequelæ of varicella have been mentioned by writers, among which we may mention anæmia, pemphigus, urticaria, bronchitis or bronchi-pneumonia (Meigs and Pepper), ulcers leading to glandular enlargements and tuberculosis, and nephritis (Henoch, Janssen, Oppenheim).

Diagnosis.—Obviously, the only diseases with which varicella is liable to be confounded are such as present vesicles at some stage of their course. From the local vesicular eruptions this disease is diagnosticated by the fact that the vesicles appear on all parts of the surface. It is sometimes mistaken for variola or varioloid, or *vice versâ*—a mistake very damaging to the reputation of the physician. The points of differential diagnosis are the symptoms of invasion—severe and lasting three or four days in the one, mild and continuing only one day in the other; an eruption passing slowly through its stages from the papular to the pustular, umbilicated, with circular, raised and inflamed base, appearing first on the face and neck, and not till a day later on the legs, in the one disease; while in the other the evolution, shape, and course of the eruption, as described above, are materially different. By proper attention to these distinctive features it is rarely difficult to diagnosticate varicella.

Prognosis.—In ordinary uncomplicated varicella this is always good. Gangrenous varicella, which is very rarely seen in America, may be fatal, and complications may render a case grave.

Treatment.—On account of the general mildness of varicella, prophylactic measures, as isolation of the patient, are seldom enforced in America, and the disease, when not complicated or gangrenous, requires little treatment; but the patient should be quiet and indoor during its continuance. Large vesicles upon the face should be punctured early and irritation by rubbing should be avoided. Complications and gangrenous varicella require appropriate treatment, especially supporting remedies. Anæmia or glandular swellings remaining after varicella require tonics, especially cod-liver oil and syrup of the iodide of iron.

CHAPTER VII.

DIPHTHERIA.

DIPHTHERIA is one of the most dreaded, one of the most fatal, and unfortunately one of the most common, maladies of childhood. It is believed to be produced by a micro-organism. It is characterized by the occurrence of a grayish-white pellicle upon the mucous surface or the skin deprived of its protecting epithelium. The specific principle is ordinarily received by the inspiration of infected air, but it is sometimes received by direct contact of infected matter with one of the surfaces not lying in the respiratory tract.

Diphtheria is a disease of antiquity. M. Sanné mentions the following names by which it has been known in different countries and at different periods: ulcus Syriacum, ulcus Ægyptiacum, garrotillo, morbus suffocans, affectus strangulatorius, pestilentis gutturis affectio, pedancho maligna, angina maligna, anginosa passio, mal de gorge gangréneux, ulcère gangréneux, angina polyposa, angine maligna, croup, diphtheritis, diphtheria. These terms, expressing the prominent characteristics of diphtheria, render it probable that this was the disease alluded to.

It is impossible to state or form a probable conjecture in regard to the time when diphtheria originated, but its origin probably antedated the Christian era. According to Aurelianus, Asclepiades, who lived one hundred years before Christ, scarified the tonsils and performed laryngotomy for the relief of respiration, and it is supposed that he treated cases of membranous croup, and probably diphtheria. Aretæus, a Greek physician of Cappadocia at the commencement of the Christian era, gives in writings still extant a clear and accurate description of mild and severe diphtheria. After describing what he designates ulcers upon the tonsils, "covered with a white, livid, or black concrete product," he adds: "If the malady invades the chest by the trachea, it causes suffocation on the same day. Children up to the age of puberty are most exposed to this disease." He gives also a graphic and truthful description of the suffering of the child when the disease extends to the larynx, and croup results. Galen, in the second century, apparently alludes to diphtheria when he describes a fatal disease prevalent in his time in which fragments of "membranous tunic" are expelled. He states that he is able to determine by the manner in which the fragments are expelled, by coughing or spitting (hawking), whether they are detached from the larynx or the pharynx. Cœlius Aurelianus, a Latin physician who is supposed by some to have lived in the second century, and by others as late as the fifth century, describes a grave angina in which the symptoms which sometimes arise correspond with those in diphtheritic croup and diphtheritic paralysis as observed at the present time. In the fifth century Aëtius of Amida described a disease accompanied by "crusty and pestilential ulcers," sometimes having a whitish and in other instances an ashy or rusty color, and not preceded by a discharge. Aëtius alludes to the hoarseness which he says sometimes supervenes and is a source of danger up to the seventh day.

From the close of the fifth century until the sixteenth the record of diphtheria is broken. It is probable that during the long period embraced in the Dark Ages every decade witnessed epidemics of this fatal disease, but if they were observed and recorded the records were lost, the literature of diphtheria sharing the fate of general literature during this time of intellectual darkness.

In the sixteenth century epidemics of diphtheria occurred in various parts of Europe, and clear and unmistakable descriptions of them have been preserved. From the sixteenth century until the present time diphtheria has continued to be one of the most frequent and fatal of the epidemic diseases upon the European continent, and it is apparently permanently established in its great cities.

It is a remarkable fact that those pestilential diseases which desolate families and communities in modern times originated in the Eastern hemisphere, chiefly in Asia or Africa, and extended to the Western nations through commerce or navigation. The aborigines of America had in their primitive state no ailments, so far as we can ascertain, except such as occurred from vicissitudes of temperature or were incident to age and their wild and exposed nomadic life. Pernicious to them was the discovery of America by Europeans for various reasons, but especially because it led to the introduction of the contagious and pestilential maladies. The cruel and rapacious gold-hunters under Cortez introduced smallpox into Mexico, and for ages afterward throughout Central America heaps of skeletons of those who perished of this disease were found in shaded and out-of-the-way localities where they had been taken by their friends. Adventurers from the Old World introduced the eruptive fevers and the loathsome contagious diseases of vice and immorality into the islands and upon the continent of North America. The medicine-men of the Indians had by their incantations gained great repute in the management of the diseases with which they were familiar in their wild life in the forests, but they were unable to cope with the new diseases which the vessels of the foreigner had brought to this Western World.

Of all the diseases which America has received from Europe, the one most dreaded, because of its highly contagious character, the great mortality which attends it, and the extreme suffering which certain forms of it produce, is diphtheria. It is to be, from appearance, above all other maladies the scourge of America in the future. It is probable that the first cases of diphtheria in America occurred in or near Boston. Josselyn made two voyages to New England in 1638 and 1663, remaining eight years in this country after his second arrival. He states that the Europeans residing in New England are greatly afflicted by a disease "which hath proved mortal to some in a very short time, quinsies and impostumations of the almonds, with great distempers of colds."[1] At Roxbury, Massachusetts, in 1659, three children in a family were attacked by the "malady of bladders in the windpipe," all dying within two weeks.[2]

At the close of the seventeenth century and in the first half of the eighteenth century epidemics of diphtheria occurred in various parts of New England. At Kingston, New Hampshire, in March, 1735, a child died of three days' sickness of a throat affection. A week subsequently three children in another family, four miles distant from the first case, also died of a three days' sickness. The malady continued to spread and the first forty cases all perished. They died of a disease located in the throat, neck, and air-passages, attended in many of them by swelling of the cheek or neck. The disease from Kingston spread to other townships, but in its subsequent course it was milder than at first. We recognize in this nameless disease the characteristics of diphtheria.

In August, 1735, in Boston, a child had a disease of the fauces attended by white spots. In the following month several similar cases occurred in different parts of Boston. In October of the same year a young man lately

[1] Wm. Veazie, Boston, 1865.

[2] *Historical Researches of Dr. Elsworth Eliot.*

arrived from Exeter, New Hampshire, where a brother had died of this new disease, himself sickened with it in a more severe form than had yet occurred in Boston. Diphtheria, thus established in Boston, was epidemic during the following winter and spring months. At the height of the epidemic, in the second week of March, 1736, the burials increased from an average of ten to twenty-four through the prevalence and severity of the new disease. Two years later (1738), a monograph appeared from the pen of I. Dickinson, A. M., Boston, bearing the title, "Observations on that Terrible Disease vulgarly called the Throat Distemper, with Advices as to the Method of Cure, in a letter to a friend." The writer of this epistle, though a clergyman, appears to have been a close observer. He probably, as was not unusual at that period, practised both as physician and clergyman. Dickinson's graphic description shows that the disease in his day presented the same characteristics as at present.

Diphtheria, thus established in Eastern New England, spread westward through the intercourse of the inhabitants, reaching New York in about two years. Dr. Cadwallader Colden, writing in 1753, had already carefully observed diphtheria. He remarks: "When the disease first appeared it was treated in the usual way for a common angina, and no plague was more destructive. . . . . The orifices made by the lancet in bleeding and the adjacent parts were apt to become diseased; so likewise the places where blisters were applied." He recognized the fact, now well known, that in exceptional cases the throat remains unaffected, while the diphtheritic inflammation and exudate appear upon other surfaces: "A girl about ten years of age, while the throat distemper was prevailing, had sores on her private parts, like those on the tonsils of others, but no symptom of the disorder appeared in her throat." Dr. Jacob Ogden, writing from Jamaica, Long Island, in 1769, and again in 1774,[1] described diphtheria as it occurred in his practice and in the adjacent townships. He recommended the use of sènega and calomel. But the American physician of this period whose writings contributed most to a correct understanding of diphtheria was Samuel Bard of New York (1771). He possessed a mind admirably qualified for scientific investigations, and especially for study of an obscure disease, basing his opinions upon accurate clinical examinations. A recent appreciative reviewer, Dr. John C. Peters, says: "Bard's article is among the calmest, wisest, and most accurate that has ever been written on diphtheria, both before and since his time." He recognized the fact that the various forms of diphtheritic inflammation were identical in nature, and, however differing in appearances, had the same underlying cause.

In the first half of the present century diphtheria was regarded as a very important disease in Europe, and was made the subject of investigation by the most renowned clinical teachers, among whom we may mention Jurine (1807), Bretonneau (1821), Bourgeoise (1823), Gendron (1825), Billard (1826), Deslandes (1827), Blanquin (1828), Broussais (1829), Trousseau (1830), Cheyne (1833), Fricout and Burley (1836), Boudet (1842), Guersant and Blache (1844), Moland (1845), Damot (1846), and Heine (1849). During this half century, ending with 1850, which witnessed such an augmentation of the literature of diphtheria in Europe, this disease attracted but little attention in America. It appears to have been much less prevalent on this continent than in the Old World. It may have occurred in small epidemics in various localities from the time of Dr. Bard until 1850, but they attracted so little notice from American physicians that no monograph or communication to medical journals relating to diphtheria, which was worthy of preservation, appeared during this long period.

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[1] See *Medical Report*, vol. v., 1802.

Since 1850 epidemics of diphtheria have occurred in numerous localities in North America, not only in the cities with their sewers and crowded tenement-houses rendering the air impure, but also in the sparsely-settled and mountainous sections, where no impurities in the air exist. But diphtheria is most prevalent and fatal in the cities. During the last quarter century it has become established in most of the larger cities in the Northern and Western States from the Atlantic to the Pacific coast, along the line of commerce and travel. The permanent establishment of diphtheria in the centres of trade and travel, and the fact that many have this subtle malady in so mild a form that they are not aware of it, and mingle with others in places of resort, inevitably tend to disseminate the disease throughout the country. Hence in rural localities intervening between the cities outbreaks of diphtheria of unknown origin are common in at least all the eastern, northern, central, and western portions of the United States and in Canada. Consequently, in the last two decades in America diphtheria has been the subject of discussion at numerous meetings of medical societies, many cases of interest have been reported, and histories of epidemics and statistics of treatment have been published in the medical journals. Therefore, the American literature on diphtheria is abundant and rapidly accumulating, and to the genius and perseverance of an American (O'Dwyer) the world is indebted for the means of combating more successfully than in former times the most painful, most dreaded, and most fatal form of diphtheritic inflammation.

In Europe diphtheria is established in the centres of medical education, as Paris, Berlin, London, and more recently Vienna. It has in these cities, and in smaller cities and towns where it has occurred, been the subject of much discussion and investigation. In Europe, therefore, as well as in America, the literature of diphtheria has been greatly increased during the last decade by reports of cases, histories of epidemics, and statistics of treatment. In six consecutive months in 1888 the deaths from diphtheria in ten of the principal cities of Europe were as follows:

	Deaths.	Population.		Deaths.	Population.
Paris	1047	2,260,945	Buda-Pesth	207	442,787
London	852	4,282,921	Copenhagen	210	300,000
Berlin	523	1,414,980	Christiania	196	135,600
St. Petersburg	341	928,016	Prague	161	300,828
Vienna	251	1,212,232	Amsterdam	136	390,016[1]

In Madrid, with a population increasing from 136,663 in 1880 to 157,965 in 1885, the deaths from diphtheria during the six years ending with 1885 were as follows:

In 1880	242	In 1883	1027
" 1881	799	" 1884	1079
" 1882	587	" 1885	1350[2]

Among the American physicians who have recently advanced our knowledge of diphtheria are Drs. Curtis and Satterthwaite of New York, in their "Report on the Pathology of Diphtheria," made to the New York Board of Health; Drs. Wood and Formad of Philadelphia, in their "Memoir on the Nature of Diphtheria," prepared and published by the National Board of Health in 1882; and Drs. A. Jacobi and C. E. Bellington in their treatises on diphtheria (1880, 1889). In Europe during the same period interesting and instructive monographs have been published by Peters, Birch-Hirschfeld,

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[1] *Bull. gén. de Thér.*, October 30, 1888.

[2] *La Higiene*, October, 1888.

Rosenbach, Leyden, Wagner, Fürbringer, Fischl, Weigert, Meyer, and others.

ETIOLOGY.—During the last twenty years numerous experiments and microscopic examinations have been made in order to elucidate the cause and nature of diphtheria. Each year of investigation has strengthened the belief that the cause is a microbe, but it is still a matter of doubt which microbe is the causal agent, or whether there may not be more than one species of bacteria which by their action upon and in the tissues produce diphtheria.

Between the years 1868 and 1873 many of the leading pathologists of Europe believed that the cause of diphtheria had been discovered—that it was the micrococcus or spherical bacterium. During the decade commencing with 1868 no subject in pathology attracted so much attention as the relation of the micrococcus to diphtheria. Oertel (1868) discovered micrococci in the diphtheritic pseudo-membrane and in the blood, lymphatic vessels, and kidneys in severe diphtheria, appearing as "point-like, dark-contoured, round or oval little bodies isolated, and in zooglœa." In later investigations (1874) he found a larger or smaller number of the bacterium termo accompanying the micrococcus, and he expresses more firmly the belief that micrococci lodging on the mucous surface cause the diphtheritic inflammation. He produced croup in rabbits by applying ammonia, and found few or no micrococci in the false membrane, and never in the blood or internal organs. He inoculated the trachea of rabbits, pigeons, and chickens with the diphtheritic membrane, and produced local lesions apparently identical with those of diphtheria in man, and the blood of the animals subjected to the experiment contained micrococci in abundance. Nassilof[1] states as the result of his observations that fungi, not designating the species, are always present in diphtheritic membranes and precede their development, and that they penetrate the tissues by the blood-vessels and lymphatics before any observable change occurs in the tissues. Therefore he believes that they cause the diphtheritic imflammation. Hueter and Tommasi inserted particles of the diphtheritic membrane in the back of the rabbit. Death occurred in forty hours. Micrococci were found at the seat of the injury and, before death, in the blood of the animal. Similar experiments and observations made by other pathologists of renown strengthened the belief that the cause of diphtheria had at last been discovered in the micrococcus. Cohn (1872 and 1873) classified this organism, which had now assumed great importance, with the schizophytes, tribe sphæro-bacteria, and he designated it *micrococcus diphtheriticus*.

On the other hand, Eberth (1872) and Krebs (1871) expressed the opinion that the diphtheritic micrococci are the same as septic micrococci. Senator (1874) states that other diseases of the mouth and pharynx are accompanied by the same micrococci as those in diphtheria. They are also, he says, found in the mucus between the teeth and in normal urine, and the micrococci of diphtheria do not differ in cultures from those occurring in other conditions. Billroth (1874) also dissented from the opinion that micrococci caused diphtheria. He made the broad statement that "the so-called pathogenic bacteria of diseases are positively identical with those found in putrefying dead tissues." Therefore the theory that micrococci alighting upon one of the surfaces caused diphtheria met with strong opposition soon after it was announced, and as time went on facts and observations which militated against it multiplied.

In 1877, Drs. Curtis and Satterthwaite were employed by the New York Health Board to investigate the etiology and pathology of diphtheria. After many experiments they reported "that the bacteria of diphtheritic membranes do not differ in optical or chemical behavior from those found in putrescent but non-diphtheritic animal material." They also found that "scrapings from the upper surface of a somewhat furred tongue from a healthy person" cause, when inserted in the cellular tissue of the rabbit, an effect exactly similar to that produced by inoculations with diphtheritic membrane. Putrid Cohn's fluid (an aqueous solution of ammonic tartrate, potassic and calcic phosphates, and magnesic sulphate) also caused the same result. They were enabled, after many carefully-conducted experiments, to enunciate the following propositions: "Thorough trituration of proven virulent diphtheritic membrane and tongue-scrapings with a high percentage of salicylic acid fails not only to remove, but even markedly to modify, the intensity of the infectious quality of those substances. Hence, since salicylic acid in even a minute percentage is capable of permanently suspending the vital activity of bacteria, the inference is that the infectious quality of diphtheritic membrane upon the system of the rabbit is not correlated to the vital activity of the bacteria present in such membrane." Therefore if, as is probable, the agent in the pseudo-membrane which causes the noxious effects in the inoculated rabbit be the same as that which causes diphtheria in man, it follows "that *there is no theoretical ground for assuming that preventing the bacteria of a diphtheritic patch from making their way through the underlying mucous membrane will, per se, prevent general diphtheritic infection of the system.*"

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[1] *Virchow's Archiv*, 1870.

These important observations and opinions, expressed by Curtis and Satterthwaite in 1877, evidently prepared the way for the theory that the bacteria themselves are not the cause or the infectious principle of diphtheria, but chemical substances or ptomaïnes produced by the agency of the bacteria may be.

In 1882, Drs. Wood and Formad, employed by the National Board of Health to investigate the nature of diphtheria, after many microscopic examinations and experiments declared their belief that the micrococcus diphtheriticus and m. septicus, inasmuch as they responded alike to optical, chemical, and vital tests, are identical. They found the same micrococcus in the unhealthy pus of erysipelatous cellulitis, and in 21 instances in which death resulted from inoculations with this pus they found the same micrococci in the blood of the victims. The blood of 22 cases of erysipelas was examined for micrococci, with the following result: "In 13 of these the organisms were found in the blood, whilst in the other 9 there were none. Of measles, 29 cases were studied: in 6 only were micrococci detected, whilst in 8 cases of rötheln, or German measles, there were no organisms. We have also investigated 4 cases of malignant fatal scarlet fever, in all of which we found the blood a few hours before death loaded with micrococci, both free, attacking the white corpuscles, and in zooglœa masses, and in one of which micrococci emboli were abundant in the kidneys. We have also studied 4 cases of 'puerperal fever,' probably septic metritis, in all of which micrococci existed in the blood before death."

It soon became apparent to pathologists, from experiments and observations like the above, that the so-called micrococcus diphtheriticus is not peculiar to diphtheria—that it occurs in all pestilential and putrid diseases, in decomposing animal tissues in various diseases, and even upon the tongue and gums in health. Hence it was necessary to look elsewhere for the cause of diphtheria.

In 1883, Klebs made extended and thorough examinations of the microbes of diphtheria, and formed the opinion that a bacillus which he had observed in the pseudo-membrane and upon the inflamed tissue merited special attention. Subsequently, Loeffler pursued the investigation, and the organism known as the Klebs-Loeffler bacillus became a prominent object of study as perhaps the causal agent in diphtheria. Loeffler, in the published statement of his investigations, remarks that all observers have found bacteria in the diphtheritic exudate, micrococci most frequently, existing in colonies, and especially abundant in superficial portions of the pseudo-membrane. At times bacteria have been found in the lymphatics in the vicinity of the inflamed tissues. Every diphtheritic patch contains many species of bacteria which have been cultivated, but as they have not been isolated the specific germ of diphtheria has not been determined. The rejection of the theory that micrococci are the causal agent of diphtheria, on the ground that they occur, presenting the same optical, chemical, and vital characteristics, in other distinct diseases and conditions, led to a more careful examination of other bacteria present in the diphtheritic exudate and upon and in the underlying tissues. The bacillus described by Klebs, and later by Loeffler, is motionless, partly straight, partly curved, of the length of the tubercle bacillus, but double its thickness. It is abundant in the pseudo-membrane, but is not found in the blood-vessels, lymphatics, or internal organs; so that its pathogenic action must be localized on the surface. If it be the specific principle or germ of diphtheria, it must act by producing a ptomaïne or chemical poison where it is lodged, which poison, entering the lymphatics and blood-vessels, causes systemic infection. In some typical cases of diphtheria Loeffler was unable to find the bacillus—which of course militates against the theory that it is the specific germ—but he suggests that it might have died and been eliminated before the death of the patients. Such an explanation seems very improbable; it is making a stubborn antagonistic fact yield to a theory; and yet without such an explanation we must look for some other cause of diphtheria. The Klebs-Loeffler bacillus was found by Loeffler in the exudate in thirteen cases of diphtheria, and cultures to the twenty-fifth generation inoculated in guinea-pigs and birds caused a whitish exudation at the point of inoculation.

W. Watson Cheyne[1] recognizes the importance of Klebs and Loeffler's researches, and thinks it probable that the micro-organism which causes diphtheria is a bacillus, which, lodging upon the surface of the throat, is propagated there. Having upon the mucous membrane a favorable nidus, it not only lies upon, but penetrates, the superficial portion of the mucous layer and causes the exudation of fibrin. The pseudo-membrane thus produced consists, according to Cheyne, of the fibrinous exudate and dead epithelial cells. As the bacilli multiply and extend, the exudate enlarges. Cheyne believes it probable, though demonstration is lacking, that the bacilli cause very poisonous ptomaïnes, which, entering the lymphatics and the blood, give rise to systemic infection and render the disease constitutional.

But since the observations of Klebs, Loeffler, and Cheyne the bacillus which they consider the specific principle of diphtheria has been subjected to a more thorough examination, with the result of apparently demonstrating that the same bacillus occurs in non-diphtheritic cases, and even in healthy persons, as well as in diphtheria. Thus, Von Hofman-Wellenhof[2] detected this bacillus in 26 of 45 cases in various conditions of the buccal and faucial surfaces. He discovered it in 7 cases of diphtheria, in 3 of measles, in 6 of 19 cases of scarlet fever, and in 4 of 11 normal cases. In cultures and experiments the bacilli from different sources appeared to be identical. Therefore in the light of recent investigations the Klebs-Loeffler bacillus has no more significance as a cause of diphtheria than the micrococcus of Oertel.

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[1] *Brit. Med. Jour.*

[2] *Wiener med. Wochenschr.*, 1888, Nos. 3 and 4.

Prof. Oertel, who was one of the earliest advocates of the theory of the microbic origin of diphtheria, and whose monograph in 1868, published in Ziemssen's *Cyclopædia*, led to the belief in the profession that the micro-occus was the cause, now admits that the theory that diphtheria is due to he action of bacteria, though plausible, is not proved. He has endeavored o elucidate the pathogeny of the disease by a careful and minute study of ts anatomical characters.[1] After an elaborate study of its histology, he emarks: "In the earliest-formed membranes many varieties of microbes an be isolated; but practically there are two chief kinds—chain-forming occi (streptococcus) and rod-shaped bacteria with rounded extremities (bacilli)."[2]

Oertel remarks that in the septic form of diphtheria the cocci are abundant. In a pseudo-membrane of twelve hours' continuance micrococci abounded mostly on the surface, but in the fibrinous network the bacilli, often in colonies, preponderated. In a specimen of twenty-four hours' duration the upper surface was full of cocci, and between them were bacilli. In another specimen of membrane detached after six days these two forms of microbes were also intermixed. As regards the tissues and organs, the micrococci and bacilli occurred upon the mucous membranes, not penetrating them to any great depth. They were not found in the "necrobiotic foci," nor were they observed in any of the sections of the kidneys which were examined. This is a noteworthy fact, because in the examinations made between 1865 and 1871, the results of which were published in Oertel's article in Ziemssen's *Cyclopædia*, micrococci were found in the kidneys. He attributes their presence in the kidneys during this period to the fact that the cases under observation were septic, whereas in those recently examined septic infection was not common, on account, he thinks, of the employment of disinfecting and antiseptic measures in place of the escharotic treatment and forcible detachment of the membrane, in use during the time of his former observations.

The purpose of Oertel in his recent investigations has been to ascertain, if possible, the nature of the diphtheritic virus by a close and minute study of the lesions or anatomical changes which it produces. It appears from his examinations that the primary lesion is cell-change. "Necrobiotic processes" and "necrobiotic areas" commencing in the cells are observed in the tonsils, the mucous membrane of the fauces, uvula, epiglottis, larynx, trachea, in the cervical submaxillary, bronchial, and mesenteric glands, in the spleen, and in the follicles and agminate glands in the intestines. In different cases these structural changes vary according to the intensity of the virus and the duration of its action. The morbific process extends by propagation through an organ or from one part to another, the virus being carried by the lymph-stream or blood, disintegrating products being the carrier.

The following is a summary of Oertel's views in regard to the virus of diphtheria. They express all that is at present known of the etiology of this disease. The nature of the virus, says Oertel, is still obscure. It acts upon cells, causing their death and disintegration, and the infected particles convey the virus to other cells. The virus causes hyaline degeneration in the tissues. The hyaline degeneration in the walls of the blood-vessels causes them to rupture, producing hemorrhages. The unequal amount of hyaline change in different parts of the vascular apparatus may be attributed to difference in resisting power or unequal exposure to the infected blood. Secondary inflammatory processes in the lungs, heart, liver, kidneys, and in the central and peripheral nerve-tissues must arise from the infectious property of the blood circulating in them. After enumerating at length and with much detail the results of his examinations, Oertel expresses the opinion that bacterial organisms cause diphtheria, and that they produce this result not by their direct action, but by producing a ptomaïne which infects the system and causes the disease to be constitutional. The microbe itself is mostly confined to the surface, whereas the action of the virus is "widespread and deep." The most eminent pathologists of the present time do not express any more positive opinions in reference to the specific principle or germ of diphtheria than is contained in the above summary of Oertel's views.

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[1] *Die Pathogenese d. epidemischen Diphtherie, nach ihrer histologischen Begründung*, Leipzig, 1887.

[2] *London Lancet, March 31, 1888.*

Dr. Prudden has recently made systematic studies on a series of cases of diphtheria, which would seem to indicate that a streptococcus which is almost constantly present in the pseudo-membrane may stand in a causal relation to diphtheria.[1]

At a recent meeting of the London Epidemological Society, Dr. M. W. Taylor[2] expressed the opinion that common mould might cause diphtheria in persons exposed to it. The walls of a sleeping apartment became wet and sodden on July 12th. On the 22d a fungus appeared on the plaster, and in the beginning of August the three children who occupied the room, and who had not been exposed in any other way, so far as could be ascertained, sickened with diphtheria. The aspergillus and coprinus grew abundantly in the mould. In another instance, in which the child died in three days, there was a great development of penicilium moulds. A young man had diphtheria severely four days after cleaning out a pigeon-loft where the exuviæ, débris, and rotten wood were covered with mould. But the theory that organisms which are commonly present in ordinary mould can produce diphtheria is improbable, for mould is common in all damp localities, where there is no diphtheria as well as where diphtheria is present. We shall see in our remarks on the propagation of diphtheria that there can be little doubt that pigeons and other feathered animals frequently have this disease, and in the instance referred to by Dr. Taylor it is probable that exuviæ and débris in the pigeon-loft had been infected by sick pigeons. The specific principle must be introduced from without, but if it obtain a lodgment upon the wet and mouldy surface of any filthy accumulation, it may find there a nidus favorable for its development. We shall see that the fact appears to be fully established that the diphtheritic virus is frequently propagated in foul and damp localities, apart from the animal tissues and independently of the sick. We repeat, therefore, that the theory in reference to the causation of diphtheria which is gaining acceptance throughout the world is that it is produced by a microbe or microbes whose action is chiefly on the surface or at no great depth, and that blood-poisoning occurs mainly from a ptomaïne or ptomaïnes produced by microbic agency. In order to obtain a knowledge of the ptomaïne chemistry must aid microscopical investigation.

MODE OF PROPAGATION.—No fact is better established than that diphtheria does not originate *de novo*. Like the eruptive fevers, it is produced by the reception in or upon some part of the system of the pre-existing specific poison. The extreme contagiousness of diphtheria from person to person is well known; a moment's exposure to the breath of a patient, or in the infected room where he is under treatment or has been weeks or perhaps months previously, has in numberless instances communicated the disease. The virus adheres tenaciously to objects on which it happens to alight. The clothing of a patient, even when the disease is in its mildest form, his bed-ing, the furniture of his room, and the objects which he handles may for weeks afterward communicate the disease, and even when transported to a distance. A child with malignant diphtheria seen by me in consultation apparently contracted it by embracing a school-mate who was in the street for the first time after an attack of diphtheria. In another instance a child was for a brief period in a room where diphtheria had occurred two months previously, and after the usual incubative period sickened with the disease.

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[1] See *Amer. Jour. Med. Sci.*, 1889.

[2] *Brit. Med. Jour.*

Although diphtheria is often contracted in the manner mentioned above—that is, by exposure to a diphtheritic patient or to a room or some object infected by such patient—there is another mode of infection common in the cities. Dr. Sternberg, in his recent Lomb Prize Essay, published by the American Public Health Association, refers to the fact that damp, foul places, such as sewers, cellars, ill-ventilated spaces under floors where the sun never enters and where refuse collects, afford conditions favorable for the development and propagation of the diphtheritic virus. The virus, whatever its nature, once received, may be propagated in such a place for an indefinite time, and, ascending in the vapors which arise from this culture-bed, it is liable to communicate the disease to any one who inhales it. Thus, in New York City prior to 1850, although foul sewers and insanitary conditions existed, there was no diphtheria, but in the decade following 1850 diphtheria was introduced. Its germ made its way into the sewers underground, and now wherever sewer-gas escapes into the domiciles of this city, it carries with it the diphtheritic virus. The amazing vitality and power of propagation of the diphtheritic poison are apparent when we reflect that it permanently infects the filthy but constantly-flowing and constantly-renewed currents of the sewers of a great city. In all the wards, and apparently in every street, in New York City children are constantly falling sick with this disease, contracted by inhaling sewer-gas, which, notwithstanding "sanitary plumbing," often escapes from unsuspected sources, even in houses constructed with all the modern improvements. It is chiefly by exposure of children to infected sewer-gas which ascends from this widely-extending underground culture-bed, and to walking cases often so mild that there is little or no complaint of the throat or impairment of the general health, that this disease is so prevalent. Most of the contagious diseases of children are quickly detected by characteristic symptoms or appearances which the most ignorant families are to a certain extent familiar with, but mild diphtheria possesses so few subjective symptoms that it is often not detected or suspected, even in intelligent families who are watchful of their children. Children with mild diphtheria sit among other children in the schools, in the city conveyances, in the churches and dispensaries, and frequently communicate to those who are near them a malignant form of the disease from which the unfortunate victims quickly perish. The diphtheritic virus is so subtle, and its vitality and power of propagation so great, that when it is established in a sewered city it can probably never be stamped out, as cholera and yellow fever may be, by measures, however stringent and active, employed by health boards or by legislative enactments.

Commonly, diphtheria is communicated by the inhalation of infected air—the inhalation of air containing the specific principle, whether derived directly from a patient or from some infected inanimate object, as the walls of a room, furniture, apparel, an article of merchandise, or sewer-gas. More rarely, diphtheria is communicated by direct contact with some infected solid substance, as a particle of the diphtheritic exudate, muco-purulent secretion from an infected surface, or the blood of a patient. A considerable number of instances has been reported in which instruments infected by use upon a patient, and not properly cleaned and disinfected subsequently, have been the means of communicating the disease. In these instances of communication by direct contact the poison is received either upon one of the mucous surfaces or upon the skin denuded of its protecting epidermis.

Diphtheria contracted from Animals.—Observations are accumulating which show that diphtheria or a disease closely resembling it occurs among animals, and is sometimes communicated from them to man. The feathered tribe especially appear to be susceptible to this disease. On the island of Skiathos, off the north-eastern coast of Greece, no diphtheria had occurred during at least thirty years previously to 1884, according to Dr. Bild, the medical practitioner of the island. In that year a dozen turkeys were introduced from Salonica. Two of them were sick at the time, and died soon afterward; the others became affected subsequently, and of the whole number seven died, three recovered, and two were sick at the time of the inquiry. The two had a pseudo-membrane upon the larynx, difficult breathing, and swelling of the glands of the neck. As further evidence that the disease was true diphtheria, one of the turkeys that had survived had paralysis of the feet. The turkeys were in a garden on the north side of the town, and the prevailing winds upon the island are from the north. When this sickness was occurring among the turkeys an epidemic of diphtheria commenced in the houses in proximity to the garden and spread through the town. It lasted five months, and of 125 cases in a population of four thousand, 36 died. Diphtheria was from this time established upon the island, and frequent epidemics of it have occurred since.[1] M Menzies[2] states that diphtheria is common among the poultry in Italy, in which country the flat roofs of the houses afford a resting-place for turkeys, fowls, pigeons, and rabbits, and their evacuations are carried by the rain into the cisterns and wells. A physician at Posilippo, near Naples, had directed his servant not to obtain drinking-water from the well next to his house, but from a well at a distance. As long as the instruction was obeyed his family was well; but the servant, yielding to his indolence, finally disobeyed the command and obtained water from the infected well. Four of the children who drank this water soon took diphtheria and died. The fifth child, who did not drink the water, escaped. In 1878–79, Nicati of Marseilles observed cases which seemed to show that diphtheria is sometimes contracted from fowls.[3] The *Journal de Médicine de Paris*, February 19, 1888, contains an instructive paper by Dr. Delthil on the transmission of diphtheria from animals to man, in which a considerable number of apparent instances is related. Dr. F. T. Wheeler[4] states that while in a nesting of wild pigeons he found many sick with a pseudo-membranous sore throat. He dissected some of them with his pocket-knife, which he was obliged to throw away on account of the offensive odor. There were millions of pigeons in the nesting, and they were hunted and eaten by the inhabitants. The same year diphtheria broke out in a most malignant form, causing many deaths among the children. Several years previously pigeons nested in the same locality or near by, and fully half of the children living in the vicinity had diphtheria. Dr. George Turner[5] states that a pigeon was brought to him for dissection. The whole of its windpipe was covered by pseudo-membrane, as in the croup of a child. Pigeons were inoculated in the fauces with this membrane, and a similar disease was produced, which extended to their eyes through the nostrils. An epidemic of diphtheria occurred in the village of Braughing, Hertfordshire, England, the first cases appearing on a farm where the fowls were dying of a disease similar to that in the pigeon; and on other farms where diphtheria appeared it was preceded by a similar disease in the fowls. Dr. Turner also mentions several other epidemics of diphtheria in different localities where the poultry, turkeys, pigeons, and in one locality the pheasants, perished of a disease attended by this membranous exudation. At Tougham a man bought a chicken at a low price, as it was affected by the prevailing disease, and cared for it at his home. Soon after diphtheria broke out in his family, and this case was the first in the village. Instances are also cited by Dr. Turner showing that cats, sheep, and pigs have suffered from a severe disease of the throat, probably diphtheritic, in several localities where diphtheria was prevailing among children.

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[1] *Bulletin Méd.*, January 22, 1888.

[2] *Thesis*, Paris, 1881.

[3] *Marseille Méd.*, 1879, p. 105.

[4] *American Practitioner and News.*

[5] *Journal of Laryngology and Rhinology.*

According to the observations of various experimenters, diphtheria can be transmitted from man to animals; and, if this be true, it seems probable that it can likewise be transmitted from animals to man. Trendelenburg inoculated 68 rabbits, introducing diphtheritic pseudo-membrane into the trachea through an artificial opening: 11 of the rabbits died with the symptoms and appearances of diphtheria. In control experiments he introduced various foreign bodies into the larynx of rabbits, and was unable to produce any results or lesions resembling those in diphtheria. Oertel performed 12 similar experiments, and 5 of the rabbits died after the production of pseudo-membranes. Zahn, Gerhard, Labadie-Lagrave, Francotte, and Vulpian obtained similar results from their experiments. Such observations and experiments render it probable that genuine diphtheria, equally fatal and attended by the same anatomical characters and symptoms as in man, does occur in birds, whether wild or domesticated, and in certain quadrupeds, as the rabbit. Nevertheless, we should add that certain eminent pathologists, among whom we may mention the honored name of Virchow, have doubted the identity of animal and human diphtheria. With our present light on the subject it is evident that, since our relations to the domestic animals are so close, if they are sick with any disease resembling diphtheria the same precautionary measures should be taken to prevent infection of the family as in human diphtheria.

Mr. Cole, a veterinary surgeon of Hinckley, Australia, published in the *Australian Veterinary Journal*, February, 1882, copied into the *New York Medical Record*, the account of an epidemic of diphtheria that was apparently traced to the milk obtained from a diseased cow. In 1879, Mr. W. H. Power, health inspector, investigated an outbreak of diphtheria, and believed that he traced it to the milk-supply. The cows which furnished the milk that seemed to communicate the disease had what the veterinary surgeons designate "garget," or "infectious mammitis."[1] Another similar history of an epidemic is related by the same journal that published Mr. Power's report. Prof. Damman of the Hanover Veterinary School reported in the *Deutsche Zeitschrift für Thiermedicin*, 1877, an epidemic of what seemed to be diphtheria in calves. He directed the attendant to make applications to the mouths and throats of the affected calves. This was on April 29. On May 5 the attendant became sick, complained of his throat, and was confined to bed. A pseudo-membrane appeared on his tonsils, which were highly inflamed; he had fever and enlargement of both the submaxillary and cervical glands. A dairy-maid who now took charge of the calves also had a similar but less severe attack. Milk is a culture-medium of various microbes, and that it may be the medium of communication of diphtheria as well as of scarlet fever seems probable.

The fact that the diphtheritic virus may be conveyed long distances without losing its virulence is now admitted from the many observations that have been made. Prof. C. W. Earle of Chicago read before the Ninth International Medical Congress an interesting statistical paper on the occurrence of diphtheria, often severe and fatal, in salubrious rural localities, free from sewage-gas and water-pollution, in the newly-settled and mountainous States and Territories of the North-west. Dr. Earle's statistics render it probable that the diphtheritic infection is transported long distances to these localities, being carried in articles of clothing and merchandise. The well-known tenacious adherence of the virus to objects renders it highly important that thorough disinfection should be employed before articles are removed from an infected room.

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[1] *Med. Times and Gaz.*, Jan., 1879.

AGE.—Trousseau has said that diphtheria does not spare any age, but is most common between the ages of two and five or six years. Guersant believes that the age of greatest frequency is between the second and seventh years, and Barthez and Rilliet agree with Guersant. Bouillon-Lagrange in 63 cases occurring in one epidemic treated—

Under 2 years	14 cases.	From 18 to 30 years	15 cases.
From 2 to 6 "	18 "	" 30 to 40 "	4 "
" 6 to 12 "	10 "	" 40 to 50 "	1 case.
" 12 to 18 "	9 "	Above 50 "	2 cases.

According to M. Barthez, in Sainte-Eugénie Hospital during twenty years the ages of the diphtheritic patients were as follows, adults being excluded from this institution:

Under 1 year	81 cases.	From 6 to 7 years	59 cases.
From 1 to 2 years	314 "	" 7 to 8 "	36 "
" 2 to 3 "	319 "	" 8 to 9 "	24 "
" 3 to 4 "	292 "	" 9 to 15 "	82 "
" 4 to 5 "	200 "	" 15 to 17 "	2 "
" 5 to 6 "	103 "		

Louis has shown that diphtheria may occur at an advanced age, but it is rare over the age of forty years, and very rare after the age of sixty years.

Oertel says, "In the first half year the infant organism seems to be not at all susceptible to the disease." As in scarlet fever, so in diphtheria, cases are infrequent under the age of six months, but a considerable number of cases are on record showing that it does occur even in the newly-born. Dr. A. Jacobi has collated the following cases: A child of fourteen days treated by Tigri, one of fifteen days by Bretonneau, one of seventeen days by Bednar, one of eight days by Bouchut, one of seven days by Weikert, several cases by Parrot, and eighteen cases observed by Sirédey in the Hôpital Lariboisière in the spring of 1877. Dr. Jacobi adds: "I have met with three cases of diphtheria of the pharynx and larynx in the newly-born myself. One of these became sick on the ninth day after birth, and died on the thirteenth day; the other died on the sixteenth day after birth; the third was taken when seven days old, and died on the ninth day."[1]

Certain physicians having charge of maternity wards have observed a disease occurring in newly-born infants which bears some resemblance to diphtheria, but which, if it be true diphtheria, presents anomalous features. Thus, Dr. W. S. Bigelow reports in the *Boston Medical and Surgical Journal* for March 11, 1875, 10 cases occurring between September and December, 1873, in the Boston Lying-in Asylum, all fatal but 2. The prominent symptoms and anatomical characters were dark hue of skin, hæmaturia, pseudomembranous exudation upon certain mucous surfaces, dark-green stools, spleen enlarged and dark, kidneys engorged, in some of the cases effusion of blood into the pelves of the kidneys and along the urinary tract. Dr. Bigelow refers to what appear to have been similar cases in one of the

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[1] *Treatise on Diphtheria*, New York, 1880.

European asylums. The presence of pseudo-membranous exudations on the mucous surfaces, and renal casts, raises the suspicion that the disease which gave such strong evidence of infectiousness was diphtheria. That, so far as appears from the records, the mothers remained well, does not preclude the belief that the disease of these infants had a diphtheritic origin; for in cases which we will presently relate the mothers with one exception remained well, although their infants a few days old undoubtedly had diphtheria.

A case in some respects similar to those observed by Dr. Bigelow came under my notice. Malignant diphtheria occurred in a family in West Fifty-third street, New York, in October, 1880. The patient, a boy of ten years, died, and the remaining two children, as soon as the nature of the malady was apparent, were sent from the house. Nevertheless, one of those precisely seven days after the removal was attacked by diphtheria of the hemorrhagic form, and died in less than a week. Blood escaped from the nostrils, fauces, under the skin in numerous places, causing purpuric spots, and from the kidneys or urinary tract, causing hæmaturia. The mother, who was at this time in the sixth month of pregnancy, continued greatly depressed by the occurrence, although her general health seemed to be good. She had been in constant attendance upon her children. Her infant, born three months subsequently to the occurrence of diphtheria in her family (February 6, 1881), was well developed, but it presented a similar hemorrhagic cachexia to that in the second case of diphtheria. Blood escaped from the vessels under the skin, causing blotches and prominences, and from the mucous surfaces. The bleeding was persistent and copious from the umbilicus, so that death occurred in less than a week. The diphtheritic virus is subtle and penetrating, causing the specific inflammation in the uterine walls of the parturient woman even when her fauces are not affected. Nevertheless, whether diphtheria sustains a causal relation to cases like the above is uncertain, and can be determined only by more numerous observations.

The admitted infrequency of diphtheria in the newly-born, and the statement by some writers that they have an immunity from it, induce me to relate the following cases, in which the diagnosis of diphtheria was established beyond doubt by carefully-conducted necropsies and microscopic examinations:

The New York Foundling Asylum at Sixty-First street and Tenth avenue has during the twenty-three years of its existence been remarkably free from contagious and infectious maladies, but from September 1, 1887, to April, 1888, an epidemic of diphtheria occurred in the institution. During this time five new-born infants had diphtheria, the pseudo-membrane appearing in its usual situation on the pharyngeal, nasal, and laryngo-tracheal surfaces, and in one of the cases also lining the œsophagus. Two of these infants (Cases 1 and 2) had umbilical phlegmons in addition to diphtheria, and their cases are related in our remarks on Sepsis of the New-born, pages 137 and 138, to which the reader is referred.

Case 3.—Olivia G——, born January 8th, and wet-nursed by her mother, was apparently well until January 14th, when she became restless. On the 15th, when she was seven days old, she was carefully examined, and diphtheritic patches were observed on the faucial surface; rectal temperature 100° F, respiration 36, pulse 120. She had commencing nasal catarrh, with the usual infiltration and muco-purulent discharge, which so obstructed the nostrils that she could not take the breast, and she was fed with the mother's milk from a spoon. Probably patches of pseudo-membrane were present in the nostrils, but none were observed upon the visible parts until the 17th, when the characteristic pellicle occluded the right nostril. Daily notes of the case have been preserved, and the symptoms as regards temperature, respiration, pulse, and the cyanosis bore a close resemblance to those in the above cases. Death occurred on the

18th. At the autopsy, in addition to the diphtheritic patches already mentioned occurring upon the faucial and nasal surfaces, a pseudo-membrane was found covering the larynx, trachea, and œsophagus to within one inch of the stomach. No notable change was observed in the appearance of the internal organs, with the exception of numerous points of extravasation in the lungs.

CASE 4.—Victor K——, born December 7, 1887, appeared to be in usual health until January 13th, when at the age of thirty-seven days the mother called the attention of the resident physician, Dr. Davis, to him, as he appeared to be seriously sick. His temperature was 103.2° F., and his breathing indicated acute nasal catarrh. On the following day, the 14th, the grayish-white exudate of diphtheria was observed covering the left side of the uvula. The inability to remove it by the brush or washing demonstrated its diphtheritic nature. His subsequent history resembled those given above. Death occurred on the 15th. At the autopsy no pseudo-membrane was observed except that already described.

CASE 5.—Vincent B——, born December 31, 1887, was well until January 17, 1888, when symptoms of a catarrhal nature attracted attention. The nostrils seemed to be unaffected, but upon the posterior portion of the fauces was a grayish-white patch of the usual diphtheritic appearance. By antiseptic and solvent inhalation this pellicle became smaller, and on the 21st had disappeared. The infant recovered.

Diphtheria of the newly-born is sometimes wrongly diagnosticated. Thus, in the New York Foundling Asylum, where diphtheria was occurring, the tonsils of an infant a few days after birth presented a grayish-white appearance, suspected to be diphtheritic. After its death the curator, Dr. Northrup, discovered a pultaceous state of the surface of the tonsils, but no pseudomembrane. The disease was apparently not diphtheritic; but, as regards the cases related above, diphtheria was undoubtedly present in the first three, and there can be little doubt that this was also the disease in the remaining two. The occurrence of these cases in so short a time in a small maternity service shows that under certain circumstances the newly-born infant exhibits considerable susceptibility to diphtheria.

INCUBATION.—The duration of the incubative stage in experimental inoculation is short, varying from twelve hours to three days. In Trendelenburg's experiments the incubation was mostly from one to three days; in Lagrave's, about twenty hours. In Duchamp's inoculations the animals died after forty-eight hours with the larynx and trachea, upon which the infectious material was applied, covered with pseudo-membrane. Oertel says that the rabbits upon which he experimented by inoculation of the muscles perished in from thirty to thirty-six hours, rarely after forty-two hours, the disease-process extending rapidly to neighboring tissues. When diphtheria is contracted by a child upon an excoriated or wounded surface, as after circumcision, ablation of the tonsils, or upon a leech-bite or a burn, the incubative period is short, but it may be as long as four days. Thus, the *British Medical Journal*, and subsequently the *Archives of Pediatrics*, published the following interesting case, contributed by Mr. Phillips: A few hours after the performance of tracheotomy for diphtheritic croup the same instruments were employed for performing circumcision in a child of eighteen months. Four days later a false membrane appeared upon the wound of the prepuce, which by the following day had extended over the glans, with much œdema of the prepuce and retention of urine.

When diphtheria is contracted in the usual manner—that is, by the inspiration of air containing the specific principle—the period of incubation appears to be on the average somewhat longer than when it is communicated by direct contact. My observations lead me to believe that when the incubative period is short the disease is likely to be severe, and mild when the incubative period is long. I was enabled to ascertain very nearly the incubative period in the following cases: A boy of nine years was in the same room about one hour on Saturday with a child who had fatal diphtheria. On the following Tuesday, without any other exposure, he sickened with a severe and fatal form of the disease. Mrs. E—— assisted in nursing a severe case of diphtheria from November 11 to 13, 1874, after which she returned home, several blocks away. On the evening of the 15th she complained of sore throat, and on the following day the diphtheritic pseudo-membrane was observed upon her tonsils. On the 19th the exudation had disappeared and she was convalescent. On the 20th her sister, who resided with her, and who had not been elsewhere exposed, was also attacked. The only other case in the family, a boy, sickened with diphtheria on December 2d. In the first of these cases the incubative period seems to have been from two to four days, while in the last it was longer. In April, 1876, a little girl died of malignant diphtheria in West Forty-first street, New York City. Her sister, aged one year, remained with her from April 14th to 17th, when she was removed to a distant part of the city and placed in a family where there had been no diphtheria. On April 24th, seven days after her removal, this infant was observed to be feverish, and on the following day, when I was called to examine her, the characteristic diphtheritic patch had begun to form over the left tonsil. In April, 1875, two sisters, aged five and seven years, resided with their parents in a boarding-house in West Twenty-second street. A playmate in the same house had symptoms which were supposed to be due to a cold, but which were diphtheritic, when one night severe laryngitis occurred and ended fatally the following day. The physician who had been summoned diagnosticated diphtheria, and the two sisters were immediately removed to a hotel. Seven days subsequently diphtheria commenced in the older child. The younger sister was then removed to a distant part of the same hotel, but six or seven days later she also was attacked. Sanné says that in 98 cases the incubative period appears to have been as follows:

From 1 to 2 days	7 cases.	From 13 to 15 days	6 cases.
“ 2 to 8 “	48 “	“ 15 to 20 “	14 “
“ 8 to 13 “	23 “		

But diphtheria is so insidious and the modes of exposure so many that in some of the cases of an apparently long incubation there may have been a second exposure. The above statistics show that the incubative period varies, but is most frequently from two to eight days.

NATURE.—Diphtheria resembles scarlet fever in certain particulars: in its incubative period, varying from two to eight days, with occasional cases outside of these limits; in its variability of type, from a very mild to a malignant form; in the common seat of its inflammations—to wit, upon the fauces and nasal passages; in the profound prostration and blood-poisoning in the graver cases; and in the frequent occurrence of nephritis as a complication or sequel. It resembles both scarlet fever and smallpox in the fact that it has the twofold mode of communication through the air and by contact or inoculation. It resembles erysipelas in the variableness of its duration, and in the fact that one attack does not prevent the occurrence of another. In its etiology it resembles typhoid fever; for it is not only communicable from person to person, but it is communicated by foul exhalations, as sewer-gas, in which the poison lurks. But while there are certain resemblances, it is distinguished from all these infectious diseases by marked peculiarities.

Diphtheria is primary or secondary. The secondary form most frequently occurs during epidemics of the other infectious diseases and as a complication of them. Those infectious maladies which are accompanied by inflammation of the fauces and air-passages are most liable to this complication if they occur in a locality where diphtheria prevails. In these instances of secondary diphtheria the diphtheritic inflammation supervenes upon the inflammations which pertain to the primary diseases. Scarlet fever beyond any other malady appears to furnish the conditions which are most favorable for the occurrence of diphtheria in the latter part of the first week or in the second week of its continuance. If scarlet fever and diphtheria be epidemic in the same locality, not infrequently toward the close of the first week of the former disease a sudden aggravation of symptoms occurs, and the cause is soon rendered apparent by the appearance of the diphtheritic exudate upon the faucial surface, usually upon its tonsillar portion. The discrimination under these circumstances of the diphtheritic inflammation from a severe scarlatinous angina is to be carefully made, and is sometimes not easy, for the scarlatinous inflammation, if intense, occasionally becomes gangrenous, so as to present an appearance resembling that of a pseudo-membrane. The other infectious maladies which are most liable to the diphtheritic complication are measles, variola, whooping cough, and typhoid fever, the catarrhal inflammation of these diseases changing to a pseudo-membranous inflammation.

It is an interesting and important fact that when diphtheria is contracted by a person having inflammation of one of the surfaces, the specific inflammation with the pseudo-membrane usually occurs upon the part which is already inflamed. A catarrhal inflammation, however produced, is liable under the influence of the virus to become diphtheritic and pseudo-membranous. Thus, at one time diphtheria entered the eye ward of the New York Foundling Asylum, and three children who were under treatment for inflammation of the eyelids were attacked by diphtheritic conjunctivitis, exemplifying the remark by Billroth, that "catarrhal conjunctivitis, which is so very common, may become diphtheritic."[1] Catarrhal inflammation from abrasions, burns, wounds however produced, are liable to be attacked by the diphtheritic inflammation and become covered with the pseudo-membrane. In Paris, where diphtheria is very prevalent, the circumcised prepuce has so often become the seat of the diphtheritic exudate that the distinguished surgeon Saint-Germain considers this fact a strong argument in favor of stretching, which he practises instead of circumcision. He also for the same reason among others recommends the treatment of enlarged tonsils by galvano-cautery instead of excision. However, in one instance in which I was employing dilatation of the prepuce, and in which the mucous membrane may have been injured by the operation, a severe diphtheritic inflammation set in on the following day, and extended from the tip of the prepuce to the body, with intense redness and swelling. The tonsils at the same time were inflamed and covered with the membranous exudation. Although severely sick, the patient recovered in a few days.

This general fact in regard to the nature of diphtheria and its mode of manifestation—to wit, that in one affected by it the diphtheritic inflammations appear by preference upon such surfaces as are already inflamed—has an important practical bearing. In frequent instances during epidemics of diphtheria inflammations which physicians of experience believe to be simple or catarrhal, and have diagnosticated as such to their friends, are seen in a few days to be diphtheritic. The most serious error of this kind, if it be one, is to diagnosticate and treat diphtheritic croup as a simple or catarrhal laryngitis until the increasing dyspnœa reveals the true nature of the disease. This experience always places the physician in an unfavorable light. But is it not probable that in a certain proportion of such cases the disease was at first a simple catarrhal inflammation, and that it became diphtheritic during its progress, just as scarlatinous angina or rubeolous laryngitis becomes a diphtheritic inflammation in those who contract diphtheria?

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[1] *Encyc. Pathol.*, translated, p. 267.

The frequent occurrence of diphtheria in all civilized countries during the last thirty years, and the great mortality which attends it, have awakened an interest in this malady which has led to a careful study of its causes and nature. At first these inquiries were chiefly clinical, but in later years microscopic examinations and experiments on animals have furnished important aid in elucidating the nature of the disease. The importance of these microscopic examinations and experiments cannot be overestimated. In connection with clinical observations, they render highly probable the theory which has been stated above, that diphtheria is produced by micro-organisms, which, coming in contact with the mucous membrane or the cuticle deprived of its epidermis, adhere to it, and, multiplying rapidly, act as an irritant and produce the characteristic inflammation; and the fact that since antiseptic treatment has come into general use microbes, in at least many instances, have not been found in the blood-vessels, lymphatics, or internal organs in those who have died of diphtheria, has led to the belief, as we have already remarked under the head of Etiology, that the systemic poisoning occurs through the agency of chemical products or ptomaïnes, which, produced by microbic action, are absorbed into the system. Whether this theory be entirely true or not will be determined by future investigations. If true, it of course establishes the fact that diphtheria is primarily a local disease. Whether it is primarily local or constitutional has been and is still much discussed. It is sufficient for the wants or purposes of the practising physician to be assured that in all cases, unless of the mildest type, diphtheria, if not primarily constitutional, is attended by systemic blood-poisoning very early, even on the first day, so that in all cases of average severity constitutional as well as local treatment is required. The following facts indicate the early blood-poisoning in diphtheria:

1. It is a law in pathology that those diseases which have or may have a long incubative period—say of a week or more—are constitutional.

2. Another fact which indicates primary blood-poisoning in diphtheria is observed in certain cases—namely, the *occurrence of severe constitutional symptoms for a longer or shorter time, perhaps for half a day, before the appearance of the usual inflammation.* Thus, a girl of five years, having malignant diphtheria, whom I saw in consultation, was carefully examined on the first day of her sickness by the attending physician, and, although he closely inspected the fauces, there was no appearance which indicated the nature of the malady till the subsequent day. In such cases, a sufficient number of which I have observed, there is likely to be complaint of soreness of the throat or difficulty in swallowing almost from the beginning of the general symptoms, but the pain and tenderness seem to be in the deeper tissues of the neck.

Again, treatment of the inflammations by the most reliable and efficient antiseptics and disinfectants which we possess, commenced at the earliest possible moment and repeated at short intervals, does not prevent the occurrence of indubitable symptoms of blood-poisoning in cases of a severe type. Thus, I have treated every portion of the inflamed surface, so far as it was accessible, every second or third hour with carbolic acid and other disinfectants almost from the very commencement of diphtheria, and so thoroughly that any vegetable or animal poison with which the remedies had come in contact would probably have been destroyed or rendered inert, and yet, except in mild cases, symptoms of diphtheritic blood-poisoning have occurred, and as early and uniformly as if less energetic local measures had been employed. While, therefore, I do not fail to recommend local treatment as calculated to diminish septic poisoning and relieve the inflammations, I have lost confidence in it as a means of preventing the entrance of the diphtheritic poison into the blood. Its powerlessness to prevent contamination of the blood by the diphtheritic virus is an additional evidence that this contamination occurs early.

3. *The quick succumbing of the system in certain malignant cases* is evidently due to diphtheritic toxæmia. We sometimes observe a fatal result on the second, third, or fourth day, without any dyspnœa or sufficient laryngitis to compromise life. Cases of this kind, terminating fatally even in the first day, have been reported. The system is suddenly overpowered by the poison, struck down, as it were, by the profound blood-change, while the inflammations are still in their incipiency.

4. Important evidence of the constitutional nature of diphtheria is afforded also by the *state of the kidneys*. No internal organs are so often affected in diphtheria as the kidneys, and, on account of their location and anatomical relation, it is evident that the poison first passes through the system before it reaches them. Any clinical or anatomical fact, therefore, which indicates that the diphtheritic virus has reached and affected the kidneys affords proof that it has penetrated the system and poisoned the blood. Now, the occurrence of albumen, with granular or hyaline casts, in the urine, in cases unattended by dyspnœa, affords proof of nephritis caused by the action of the poison on the kidneys.

Sir John Rose Cormack of Paris, in a series of interesting and useful papers relating to diphtheria published in the *Edinburgh Medical Journal* during 1876, states that albuminuria, and of course the nephritis on which it depends, sometimes begin as early as the first day. My observations confirm this statement, as in the following cases:

CASE 1.—L. McD——, aged three years, was first visited by me on February 29, 1876. I learned from the parents that she had been feverish during the preceding forty-eight hours and her urine very scanty. A moment's examination was sufficient to show that the case was one of malignant diphtheria, for the fauces were already nearly covered by the diphtheritic pellicle; the temperature was 103¼° F., and the pulse 140. The skin was hot and dry, and there was moderate swelling under the ears and a muco-purulent discharge from the nostrils. On account of the scantiness of the urine, the amount not exceeding f℥iv–v daily, it was impossible to obtain sufficient for examination till the following day. It was then found to have a specific gravity of 1032, to contain a deposit of urates and hyaline and granular casts, a diminished amount of urea, and a large quantity of albumen. It can hardly be doubted, from the scantiness of the urine and the large amount of albumen found when the urine was first examined, that albuminuria had been present on the first day.

CASE 2.—The following was a similar case: K——, aged four years, living in West Thirty-sixth street, was visited by me in consultation on January 29, 1875. Her sickness had also continued forty-eight hours; her fauces were swollen and covered with the diphtheritic pellicle, which was dark and offensive; respiration guttural; pulse 120; temperature 101° F.; she had a free discharge from each nostril; urine scanty, its specific gravity 1030; it contained a small amount of albumen with casts, and a large amount of urates, with no apparent diminution of the urea. Death occurred on the fourth day.

In such severe cases, in which albumen and casts are found in the urine at the first visit of the physician, there can be little doubt that the nephritis begins nearly or quite as early as the pharyngitis; and therefore, since poisoning of the blood must antedate the renal disease, diphtheria affects the system very early, probably from the occurrence of the first symptoms.

Again, there are cases, though not frequent—three I can recall to mind during the last two years in my practice—in which the external manifestations of diphtheria are very mild, even insignificant, and quickly cured, but in which the kidneys are early and severely affected. The occurrence of such cases is best explained on the supposition of an early and profound blood-change. The following are histories of two of the cases alluded to:

The house 229 West Nineteenth street, New York, is an old wooden structure, and the family which has occupied it during the last five years has been three times visited by diphtheria, the first case, that of the oldest child, proving fatal. In February, 1876, one of the children had diphtheria in a moderately severe form. He recovered, and after my visits had been discontinued his sister, aged six years, who had had scarlet fever when eighteen months old, became feverish and complained of her throat. No rash appeared on her skin, and there was apparently no coryza. Inspection of the fauces by the parents revealed a small diphtheritic patch over each tonsil. Although diphtheria was so frightful a malady to this family from their past experience, the case seemed so mild that the parents treated it without medical attendance by the remedies which had been employed for the boy. A mixture of carbolic acid, subsulphate of iron, and glycerin was applied to the fauces every third hour, sufficiently often, apparently, to destroy all bacteria or other vegetable or animal organisms with which it might have come in contact, and within two or three days the inflammation of the throat seemed to the parents to be cured. Nevertheless, with this insignificant inflammation of the fauces, so quickly subdued, and with no other apparent inflammation of the mucous surfaces, there was severe internal disease going on as the result of the general infection. The child did not regain her former appetite; she had increasing pallor, although able to play about the house; and finally, in the the third week, when I was called to see her, slight œdema of the face and limbs was observed. Her urine, which was scanty, was found to contain pus and blood-corpuscles, albumen, and granular casts, and nearly two months elapsed before, under treatment, it became normal and her health was restored.

The second case occurred in January, 1878, in West Fifty-first street. A boy aged six years, in a family where diphtheria was occurring, had slight sore throat, which abated in two or three days. It was attended by little or no exudation, and would not have been considered diphtheritic except for the circumstances in which it occurred and the subsequent history. Still, the boy remained ill and fretful, and four days subsequently his urine was found to be scanty and very albuminous; and three days later death occurred, preceded by total suppression of urine. The last urine passed, which was not more than a teaspoonful, became nearly semi-solid by heat. There had been no scarlet fever in the family.

Cases like the above, in which there is an early and profound systemic infection, with but slight evidence of lodgment of the virus upon the faucial or other exposed surface, are interesting as showing the constitutional nature of the malady, even when the symptoms and visible lesions have extreme mildness. Certain clinical observations, therefore, lend support to the theory that diphtheria, even if it be in most instances local at first, is in some cases systemic from its commencement, and seem to justify the remark made by Dr. A. Jacobi, that probably in some instances the diphtheritic virus enters the system through the lungs—a supposition which demands consideration, notwithstanding the fact that many pathologists now believe that the specific germ acts only upon the surface. Whether diphtheria be always local in its commencement or sometimes systemic, it answers the wants of the practitioner to be assured that in cases of a severe type diphtheria is systemic at so early a period that constitutional remedies are required at the first visit. He will be the most successful practitioner who fully recognizes the fact that he has to deal with a malady which has both a local and a systemic character.

DIAGNOSIS.—It is very important that the diagnosis of a case of diphtheria be early made, so that proper remedial measures may be employed at the beginning, as well as measures designed to prevent propagation. In a large proportion of cases the diagnosis is easy after diphtheria has continued twenty-four hours, since, in addition to the fever and pain in swallowing, the characteristic grayish-white pellicle has begun to form on one or both tonsils. Under such circumstances the nature of the malady is apparent on inspecting the fauces. But many cases are not so quickly and readily diagnosticated, even by experienced physicians. The diagnosis is uncertain, and is postponed until two or more days have elapsed. One reason of failure to diagnosticate early is the fact that many patients, even those old enough to express their sensations, do not complain of the throat. I have many times been informed by parents or nurses that there was no need of examining the fauces, as there was no complaint of pain in the throat, and yet on examination have observed unequivocal evidence of diphtheria. A physician practising in a locality where diphtheria is prevailing should at his first visit inspect the fauces of a child to whom he is summoned, especially if there be fever, and he will often discover evidences of diphtheria which without such examination would not have been detected.

When diphtheria has continued from twelve to twenty-four hours, external examination of the neck usually reveals some tenderness as well as fulness in the tonsillar regions, and the enlargement of the tonsils can be readily detected on palpation; but in some instances the tenderness and swelling are so slight as to be scarcely appreciable. In not a few cases it is impossible to make a positive diagnosis until the disease has been under observation some days and its progress and character have been carefully noted,, the difficulty in diagnosis arising from the fact that the membranous exudate is concealed from view. Thus, in nasal diphtheria the pseudo-membrane may be located upon the superior and posterior portions of the Schneiderian membrane, and therefore be invisible, while the anterior and visible portions of the nares and the faucial surface are hyperæmic and secreting muco-pus in abundance, but are free from the pseudo-membranous exudate. The pseudo-membrane may, and probably will, appear upon visible parts before the disease terminates, but not early enough to establish a diagnosis in the first days of the sickness. Occasionally in the milder forms of pharyngeal diphtheria membranous patches occur in the depressions of the faucial surface, and are not visible on cursory inspection. They are brought into view when the patient coughs or by firm external pressure upon the side of the neck, which elevates the depressed surfaces.

In laryngo-tracheal diphtheria diagnosis is not infrequently delayed in a similar manner. The child, without known exposure to the diphtheritic virus, becomes hoarse, and the hoarseness with fever increases. The fauces show the characteristics of catarrhal inflammation, and the nostrils are not affected or are affected but slightly. The diagnosis between catarrhal croup, non-specific membranous croup, and diphtheritic croup is uncertain. The patient may die without any visible pseudo-membrane unless the laryngoscope be used, and without a diagnosis except the general one of croup. The occurrence of albuminuria with casts may enable us to make the probable diagnosis of diphtheria, and this opinion may be confirmed by the contemporaneous or subsequent occurrence of diphtheria in other members of the family; but in other stances no such aid is obtained, and the nature of the attack continues to be a matter of probability only. Such are some of the hindrances in the way of accurate diagnosis.

The following is a résumé of the characteristics of the white, grayish, or grayish-white products of disease which occur on the faucial surface and which are liable to be mistaken for the pseudo-membrane of diphtheria. Let us first consider the characteristics of the diphtheritic exudate. It is deeply set in the mucous membrane, penetrating it and being incorporated with it. It consists of necrosed mucous tissue and firm fibrinous material exuded from the minute vessels, and it cannot be detached from the faucial surface, except at an advanced stage of the disease, without producing hemorrhage. It is surrounded by inflamed and swollen mucous membrane as the crystal of a watch is surrounded by the rim. Compare these characteristics of the diphtheritic pseudo-membrane with the products of other and distinct diseases of the pharynx. First, *follicular tonsillitis.* This is a common disease. In New York, and probably elsewhere, it frequently extends through families as if contagious, all or most of the children being affected by it. It is attended by fever and dysphagia. It has no marked premonitory symptoms, unless of very brief duration, and commences suddenly, like diphtheria, with headache, chilliness, heat of surface, the temperature often rising to 103° F., languor, and frequently pain in the back and extremities. The dysphagia attracts attention to the fauces, the surface of which is seen to be hyperæmic, especially its tonsillar portion. In a few hours a whitish material exudes from the crypts of the tonsils, consisting of the secretion of the crypts and epithelial cells, and forming rounded masses of the size of a small pin's head. The secretion, occurring as small, rounded, salient masses distinct from one another, is distinguished by its appearance from the diphtheritic pseudo-membrane, which at first is a thin, pellucid film, becoming thicker subsequently. Consisting simply of epithelial cells held together by the secretion, these small rounded masses are quickly detached by the swab or brush, when they are found to be friable, readily crushed between the thumb and fingers, and having a fetid odor. If two or more of them happen to unite, forming an appearance like that of the diphtheritic membrane, they still present the same physical characters, and are readily detached from the tonsillar surface without hemorrhage. This peculiar secretion of follicular tonsillitis is usually limited to the tonsillar portion of the pharynx, and is of short duration, ceasing to appear after two or three days. The inflammation abates soon. In a large number of cases which I have observed the clinical history of this disease has been as mentioned above, except in one instance, when death occurred apparently from a sudden extension of the inflammation to the larynx and the occurrence of œdema glottidis. The diagnosis of follicular tonsillitis from diphtheria is easily made, except as regards the mildest form of diphtheria.

Pultaceous Pharyngitis.—This form of pharyngitis usually occurs in low or debilitated states of the system. It occurs most frequently in the old and feeble and in such exhausting diseases as scarlatina and typhoid fever. As the term "pultaceous" indicates, the inflammatory product is soft and friable, coming away in fragments when touched by the brush or sponge, without bleeding or any injury to the mucous membrane. Under the microscope it is found to consist of epithelial cells, often in fragments, nuclei and nucleoli, but no fibrin. When this substance is removed, as it readily can be, the mucous membrane underneath is entire, hyperæmic, and covered by a newly-formed epithelial layer. The appearance of the pultaceous product to the naked eye may closely resemble that in diphtheria, but its friable character, its epithelial nature, and the absence of fibrin which the microscope reveals render the diagnosis certain.

Scarlatinous Pharyngitis.—The frequency of scarlet fever and diphtheria, and the facts that epidemics of the two are not uncommon at the same time, and that diphtheria often attacks a scarlatinous patient, render important the differentiation of scarlatinous pharyngitis from diphtheritic pharyngitis supervening upon and complicating the scarlatinous. Very commonly, when the pharyngitis of scarlet fever is severe, an abundant desquamation of epithelial cells occurs, which, aggregating, produce the pultaceous pseudo-membrane described above. This membrane resembles the diphtheritic in appearance, but its anatomical character, consisting as it does of epithelial cells as stated above, suffices to show that it is not a diphtheritic exudate. The grayish-white or brown product of scarlatinal inflammation seldom appears upon other parts than the tonsillar or lateral pharyngeal surfaces, whereas the diphtheritic membrane often appears upon the uvula, upon the posterior faucial surface, and in the nares, in addition to the tonsillar surface.

Gangrenous Pharyngitis.—This variety of pharyngitis occurs oftener in connection with scarlet fever than with any other malady unless diphtheria, and when it complicates scarlet fever the appearance resembles very closely that in advanced cases of malignant diphtheria. The diagnosis is not difficult if the case be observed from the beginning. The diphtheritic pseudo-membrane is in the commencement white or grayish-white. It presents the dark-gray color of gangrene only at an advanced stage by imbibition of blood and commencing disintegration. Gangrenous sore throat is from the first of a dark-gray, brownish, or even dark color. Gangrene produces a fetid breath; malignant diphtheria does not produce fetor to such an extent until decomposition begins or gangrene supervenes. Gangrene not infrequently complicates the later stages of severe diphtheria.

Herpetic Pharyngitis.—No one can mistake herpes of the fauces in its commencement for diphtheria, the minute vesicles of the former disease are so unlike the diphtheritic exudate. But when the vesicles have disappeared and are replaced by minute ulcerations, covered by a white and adherent exudate, the differentiation of herpes from benign diphtheria is not easy. The presence of herpes labialis affords presumptive evidence that the pharyngitis is herpetic, but not conclusive, for it is sometimes also present in diphtheria. Immediately after the disappearance of the vesicles small rounded concretions distinct from one another occupy their place, presenting an appearance entirely unlike that of diphtheria, which exhibits at first a film, soon becoming a thick and firm patch. It is when the concretions unite, forming a patch, that the diagnosis is difficult. I need not state that herpetic pharyngitis, like follicular tonsillitis, is often mistaken for benign diphtheria, and *vice versâ*.

Ulcero-membranous Pharyngitis.—This is an extension of ulcero-membranous stomatitis. It is characterized by a necrosis, limited in extent and superficial, of the mucous membrane. The presence of ulcero-membranous stomatitis as the important part of the disease, predominating over the pharyngeal affection, aids to a correct diagnosis. Constitutional symptoms are slight or are wanting in this form of pharyngitis. Fever, albuminuria, and glandular swellings, which characterize diphtheritic pharyngitis, are absent or insignificant. The sphacelus over the tonsils, unlike that in diphtheria, is in patches isolated from one another. The microscope reveals epithelial cells and bands of elastic fibres pertaining to the chorion as the elements in the necrosed tissue.

ANATOMICAL CHARACTERS.—The characteristic and diagnostic feature of diphtheria is the formation upon one of the mucous surfaces, usually the fauces, or upon the skin denuded of its cuticle, of a whitish or grayish-white pseudo-membrane. This membrane, occurring upon mucous surfaces lined by pavement epithelium, penetrates and is incorporated with the mucous membrane, which undergoes necrosis. The mucous membrane when the pseudo-membrane is fully formed loses its vitality and becomes a part of the pseudo-membranous mass. It cannot, therefore, be detached without tearing the fibres of connective tissue and the vessels which unite the mucous membrane to the submucous tissues, until such time as it becomes detached by the sloughing process. Upon such mucous surfaces as are lined by columnar epithelium the pseudo-membrane does not form an integral connection with the mucous membrane, but lies over it or lines it, so that it can be removed without injuring it. This form of pseudo-membrane occurs upon the respiratory tract below the superior vocal cord. Above this cord squamous epithelium lines the larynx, except in front, where columnar epithelium occurs as high as the middle of the epiglottis. If croup occur during the course of diphtheria, and a pseudo-membrane form upon the laryngo-tracheal surface in addition to that already existing upon the faucial surface, the patient has both forms of pseudo-membrane described above. Moreover, in the vicinity of these pseudo-membranous inflammations, and extending from them, we ordinarily find a catarrhal inflammation of greater or less extent—an inflammation characterized by redness and swelling of the mucous surfaces and a muco-purulent secretion, but without the false membrane. Sometimes also, when diphtheria is occurring in a family, one of the children has a simple catarrhal inflammation of the fauces of a few days' continuance. If he have a pseudo-membrane upon any of the surfaces, it is not visible. These three forms of inflammation—that in which the mucous membrane undergoing necrosis becomes incorporated with, and forms an integral part of, the pseudo-membrane; that in which the pseudo-membrane covers the mucous membrane, but is anatomically distinct from it; and that in which no pseudo-membrane occurs, the catarrhal—we are in the habit of designating by the term diphtheritic, inasmuch as they occur from the irritating action of the diphtheritic poison. Unfortunately, the most renowned living pathologist, Virchow, restricts the use of the term diphtheritic to that form of inflammation in which mucous membrane undergoing necrosis forms part of the pseudo-membrane, while he does not apply the term diphtheritic, but the term croupous, to that form of inflammation, although occurring in a diphtheritic patient, in which the pseudo-membrane lies upon the mucous surface. This explanation seems to be necessary in order to avoid confusion in the use of the terms diphtheritic and croupous as employed by the school of Virchow.

Soon after diphtheria commences, as manifested by fever and the concomitant symptoms, we observe redness upon one of the surfaces which is to be the chief seat of the local manifestation of the disease. When the malady is contracted in the usual manner, this local manifestation is ordinarily upon the faucial surface and primarily upon the tonsillar portion. If there be a pre-existing inflammation of one of the other mucous surfaces, or a portion of the cuticle denuded of its epidermis and inflamed, the specific inflammation is likely to appear primarily upon this part, as we have stated above, with or without its simultaneous appearance upon the faucial surface.

The inflammation varies greatly in severity and extent. In a mild attack it is often limited to a part of the fauces, and there are few exceptions to the rule that the tonsillar portion is affected, the redness gradually fading away in the healthy membrane beyond. But in the course of a few hours, in all except the mildest cases, the entire faucial surface presents the characteristic inflammatory redness and swelling and its follicles are tumefied and actively secreting. In severe cases the uvula is elongated and enlarged from infiltration, and the inflammation even extends to the submucous connective tissue, which becomes hyperæmic and swollen, and the submucous lymphatic glands, especially the tonsils, also swell and are painful. The color of the inflamed surface is sometimes a deep bright red, almost like arterial blood; in other cases it is a dusky red, which indicates, if there be no croupal symptoms, an adynamic and dangerous type of the disease. The dusky-red hue is more common in secondary than in primary diphtheria.

Within a day, and usually within a few hours, from the commencement of the inflammation a small, slightly-raised, whitish or grayish spot or patch is observed, usually upon the tonsillar portion of the inflamed surface—very significant as a diagnostic sign and as a forerunner of what is to happen. This patch, termed the pseudo-membrane, gradually becomes firmer, and at the same time thicker and broader from fresh exudations underneath. It retains for a time its grayish-white color, but it becomes brownish white from age. In mild cases the pseudo-membrane is usually limited to the tonsillar surface, but in severe cases it covers the uvula, portions of the velum, the isthmus, and the walls of the pharynx, both lateral and posterior. It does not ordinarily attain a greater thickness than one-eighth to one-sixth of an inch. I have seen it, however, not far from one-third of an inch thick.

Briefly stated, the pseudo-membrane of diphtheria is found to consist of fibrin, forming a delicate interlacing network, epithelial cells more or less altered by the inflammatory process, leucocytes, nuclei, mucus, and amorphous matter. It also contains, as has been remarked above, different species of bacteria, of which the micrococci are most abundant. The significance of the bacteria is fully dwelt upon elsewhere in this article. The same pseudo-membrane is often firmer in one part than in another, the outer and central portions being more compact and tough for a time than that underneath, which is more recent. After a few days, however, decomposition begins, and then that which was first formed becomes softer than the more recent production. When this occurs, the color of the exudation changes to a dirty brown, and its exposed surface is uneven and jagged from the partial separation of shreds and fibres. Sometimes the diphtheritic patch has a reddish tinge, due to rupture of the capillaries and escape of blood-corpuscles. Its lower or attached surface may be blood-stained, while the exposed surface has the usual grayish-white hue.

The inflamed mucous membrane is not only hyperæmic and infiltrated with serum, but it also contains numerous round white corpuscles (leucocytes), which may result in part from proliferation of connective-tissue corpuscles, but are believed by most pathologists, since Cohnheim's well-known discovery, to be in great part wandering white corpuscles of the blood which have escaped through the walls of the blood-vessels along with the fibrin. In the commencement of the diphtheritic inflammation, before the pseudo-membrane forms, we often observe a grayish tinge of the mucous surface, which is due to the crowding of the cellular elements in and underneath the mucous membrane; for these newly-formed cells not only infiltrate the mucous membrane, but can also be traced into the submucous connective tissue. Even where the inflammation remains catarrhal, as it does over certain areas in all cases of diphtheria, this infiltration of the mucous and submucous tissues with cells is common.

During the active period of diphtheria it is often astonishing to see with what rapidity the pseudo-membrane returns when removed by force. A few hours suffice to restore it as firm and extensive as before the interference. In the most favorable cases the membrane is detached in a few days, and is not reproduced. Its separation is promoted by the secretions underneath, especially by pus, which is secreted in abundance between it and the tissues underneath, which have preserved their integrity. In most instances it does t separate in mass, but disappears by progressive liquefaction. Occasion-y, even in cases which do not present a severe type, the diphtheritic ch does not disappear until the lapse of four or five or even six weeks, if it softens and is detached another appears in its place. In these stances of an unusual prolongation diphtheria has been designated ronic.

Such are the appearances, character, and history of the pseudo-membrane n this malady. Although its common seat is upon the fauces, and in mild ases it is limited to them, nevertheless all the mucous surfaces are liable to e attacked by the inflammation in consequence of infection of the blood, and therefore in severe cases, and even in cases of moderate severity, we often find the product elsewhere as well as upon the fauces, and in localities where from its mechanical effect it greatly increases the danger and even compromises life. The mucous membrane of the nostrils, mouth, larynx, trachea, bronchial tubes, Eustachian tube, conjunctiva, œsophagus, stomach, intestines, vagina, prepuce, and even the delicate lining membrane of the middle ear, are at times the seat of diphtheritic inflammation with the characteristic product. In a case which occurred in the Nursery and Child's Hospital of New York the surface of the stomach was almost completely lined by the diphtheritic formation, so as apparently to abolish the function of this important organ. The occurrence of the pseudo-membrane in the nares is common, and is attended by the discharge from the nose of thin mucus and pus. Nasal diphtheria involves great danger, from the fact that it is likely to give rise to systemic infection of a grave type. In the nursing infant it is also dangerous, since by its mechanical effect it interferes with lactation. The thin, irritating discharge produces excoriations around the nostrils and upon the upper lip. I have met only one case of diphtheritic inflammation of the intestines in which the diagnosis was certain. A physician in whose family diphtheria was occurring became seriously sick with symptoms which closely resembled those of typhoid fever. After a long sickness he expelled per rectum about one foot of pseudo-membrane of a cylindrical form, evidently derived from the surface of the intestines. In the subsequent months the patient suffered from constipation and severe abdominal pains, apparently due to contraction in healing of the large intestinal ulcer. Death finally occurred from this state of the intestines. The formation of the diphtheritic pellicle upon the vulva and vaginal walls is not infrequent, and in parturient women exposed to diphtheria it sometimes occurs upon the uterine walls, usually with a fatal result. A considerable number of cases are on record in which diphtheritic inflammation occurred upon the prepuce after circumcision, producing the usual pseudo-membrane, and in one instance in my practice, referred to above, it attacked the prepuce the day after I had dilated it with an instrument clean and free from infection.

In mild cases of diphtheria, in which the pellicle is small, superficial, and limited to the fauces, systemic infection is usually slight; and it is the belief of many that the disease when of this mild type not infrequently remains local. But in grave cases, in which the diphtheritic pellicle is extensive and deeply imbedded, systemic infection commonly results, notwithstanding the efficient local antiseptic treatment. The lymphatics and blood-vessels which are in immediate relation with the under surface of the pseudo-membrane take up poisonous ptomaïnes. Septic blood-poisoning is likely to occur in those cases in which the pseudo-membrane has become dark-gray and friable from decomposition, producing an ichorous discharge and offensive breath.

The Blood.—The blood in cases of a severe type is usually darker than in health and the clots soft. After death from diphtheritic croup it is also dark from the excess of carbonic acid in it. The chemical changes which the blood undergoes in diphtheria are partially known. MM. Andral and Gavarret found a notable diminution of fibrin in grave infectious diseases, as typhoid fever, puerperal fever, etc., and it is not improbable that the same is true of diphtheritic blood, although the exudation of fibrin is so abundant. M. Bouchut and others have noted an excess of the white corpuscles in the blood in diphtheritic patients, so that, instead of three or four in the field of the microscope, as many as sixty have been counted. M. Sanné writes of diphtheria: "It is necessary to recognize in the dark-brown blood an abnormal accumulation of the débris of the red corpuscles, débris of little abundance in the normal state, augmented considerably under the noxious influence of the diphtheritic poison, which has rapidly produced destruction of a great number of globules."[1] Small extravasations of blood in the various organs are among the most constant lesions. They have been most frequently observed in the brain and its meninges, the lungs, spleen, and kidneys. In one case which I examined after death in the New York Foundling Asylum the extravasations in and under the gastric mucous membrane produced mottling as great as that of the skin in measles.

The most minute examinations of the organs in diphtheria yet published are those recently made by Oertel, and we will present a summary of them in the following pages.

Brain and Spinal Cord.—The anatomical changes occurring in these organs are in a measure described in our remarks on diphtheritic paralysis. Oertel discovered, as the earliest anatomical change in the brain and spinal cord as well as in the membranes, a venous hyperæmia, with small extravasations of blood, "not larger than a pea," in the white medullary matter of the brain, while in the cortical layer and in the central parts no extravasation was found. In the most severe forms of the disease small hemorrhages not larger than a pea were found not only in the cerebral meninges, but also in various parts of the brain. These produced some softening in their immediate neighborhood. These small hemorrhages have been found also in or upon the medulla oblongata and spinal cord, but with less softening. Buhl, in addition to the extravasations in and upon the brain and spinal cord, discovered in one case great enlargement of the anterior and posterior roots and the ganglionary swellings of the spinal nerves. The swelling was found to be due to the accumulation of cells and nuclei in the sheaths of the nerves and to extravasations of blood. These anatomical changes were most marked at the roots of the lumbar nerves. (For further particulars relating to the pathology of the nervous system in diphtheria the reader is referred to our remarks on Paralysis.)

Tonsils.—Covering these organs is the pseudo-membrane, consisting of the usual fibrillar meshwork, enclosing leucocytes, changed epithelial cells, and amorphous matter: the older the exudation the coarser is the network. The adenoid tissue and the septa have undergone hyperplasia. The follicles are crowded with cells which have undergone necrobiosis. As a result of the necrobiosis masses are formed of various shapes and sizes, staining deeply. In consequence of the necrobiosis and degenerative changes the follicles become a hyaline network infiltrated with leucocytes and granules. In advanced cases the adenoid and connective tissues undergo a similar necrobiotic change, and are so blended with the pseudo-membrane that it is difficult to determine where the latter ends and the tonsillar tissue begins. The vessels of the tonsils undergo a hyaline thickening of their walls, and if this occur chiefly in the intima total occlusion may result. In the tissues immediately surrounding the tonsils hyaline degeneration of the muscular fibres enker's degeneration), and the connective tissue between the mus- es is infiltrated with leucocytes.

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[1] *Traité de la Diphthérie*, p. 107, Paris, 1877.

al Surface and Uvula.—These parts are often also covered with embrane, and are more or less changed by the application of reme- e line of separation of the exudate and underlying tissues cannot distinguished. The upper portion of the diphtheritic pellicle is bacteria and with leucocytes and other cells which have under obiosis. In the mucosa next to the pseudo-membrane hyalin ion of the connective tissue occurs, and the mucosa is infiltrate which have undergone marked changes. The nuclei of the con sue cells exhibit various stages of degeneration and decay, though nay retain their form. The deeper layers of the mucosa, like the infiltrated with leucocytes.

ula in severe cases is usually swollen and œdematous, and some- irely covered by the diphtheritic pellicle. When the uvula is in the general faucial inflammation, necrobiosis of the cells and urs in every part of it. The cells in the arterial adventitia and ivascular tissue exhibit necrobiotic change, their nuclei being dis- . In the uvula, also, hyaline degeneration occurs in the walls of s.

ttis.—The epithelial cells covering the epiglottis undergo marked on early in the disease, and are infiltrated with leucocytes. They n to undergo degeneration, forming granular masses. Areas of occur, and finally hyaline degeneration of the network takes place. cytes extend deeply into the mucous membrane, followed by degen- d necrobiotic changes. In places the epithelium is thrown off, and membrane forms of exuded fibrin and necrobiotic leucocytes and . Bacteria, along with leucocytes and degenerated epithelial cells, e meshes of the pseudo-membrane.

—The anatomical characters of the air-passages are fully treated of cle on Diphtheritic Croup. Catarrhal bronchitis is common in diph- t is not often absent in croup, and one of the chief sources of danger ease is the extension of pseudo-membrane from the laryngo-tracheal the bronchial, and the transformation of the catarrhal into a croup- mation. When bronchitis occurs the inflammation creeps down- ually from the laryngo-tracheal surface, and its severity is propor- the degree of extension. When there is a general bronchitis and liable to become croupous, the muco-purulent exudation is abun- en pseudo-membranous bronchitis occurs, there are usually portions nchial tree in which the inflammation remains catarrhal. One of sources of danger in diphtheritic croup is the extension of the on to the bronchial tubes and the abundant secretion of muco-pus, gs the tubes and prevents proper decarbonization of the blood. bronchitis becomes croupous, a thin, easily-detached film appears ntensely-red, hyperæmic, and swollen bronchial surface. It increases s and firmness and assumes a dull white color. Still later it becomes rmer, and of a brownish-gray color. Whatever the stage of the on, the pseudo-membrane can always be readily detached from the surface, since its relation to it is one of apposition, and not of inte- ection, as upon the pharyngeal surface. In the large tubes and edium size hollow cylinders, more or less complete, form; but in r tubes, if the pseudo-membrane extend to them, solid cylinders ed. Frequently, in the bronchial croup of diphtheria, while the nchial surface is intensely red and swollen, the pseudo-membrane is certain parts; in other parts it forms cylinders, in other parts still longitudinal bands of a ribbon shape are produced, and in more or fewer of the minuter tubes plugs which entirely fill the lumina and prevent the entrance of air. The alveoli beyond these plugs gradually collapse, and more or fewer of them return to the unexpanded fœtal state. From the tubes which are still pervious the muco-pus is with difficulty expectorated on account of its viscidity, and this thick secretion contains floating particles of pseudo-membrane. Pseudo-membranous bronchitis in diphtheria is in nearly all instances an extension of a laryngo-tracheal croup. It occurs, according to Sanné, most frequently between the second and sixth days.

Various forms of pulmonary disease occur in diphtheria, usually as a complication and often as a final result of the downward extension of inflammation from the larynx, trachea, and bronchial tubes. Splenization, atelectasis, and broncho-pneumonia are common complications of diphtheritic croup. Broncho-pneumonia, like pseudo-membranous laryngo-tracheitis and pseudo-membranous bronchitis, upon which it largely depends, occurs usually in the first week of diphtheria. In 121 cases of broncho-pneumonia complicating diphtheria, observed by Sanné, the pneumonia commenced in 2 on the first day of diphtheria and in 71 between the second and sixth days inclusive.

Pulmonary congestion, occupying by preference the depending portions of the lungs, especially the posterior and inferior portions of the lower lobes, is also not infrequent. It occurs when respiration is obstructed in croup and when the circulation is feeble in consequence of heart-failure. In the dyspnœa which accompanies paralysis of the pneumogastrics venous congestion of the lungs commonly occurs.

Peter found the lesions of *pleurisy* 9 times in 121 autopsies in diphtheria, and Sanné observed them in 20 cases. The latter writer says: "All forms of diphtheria, but particularly croup and pseudo-membranous bronchitis, are to be found with pleurisy. Pleurisy always accompanies some other phlegmasia."

Vesicular emphysema commonly occurs during the progress of croup. Whenever, in consequence of occlusion of the tubes, a considerable part of a lung fails to receive air, its alveoli begin to retract and collapse, and the alveoli which receive air, which are principally those in the superior and anterior portions of the lung, are over-distended, since their function is compensatory. Vesicular emphysema consequently results, and in exceptional instances the vesicles rupture and the escaped air passes into the connective tissue, producing interstitial emphysema.

Pulmonary apoplexy occasionally occurs, the extravasations usually being of small size and disseminated through the lungs. It is most frequent in malignant cases—in cases attended by profound blood-poisoning. It has been attributed in some instances to pulmonary emboli resulting from cardiac thrombosis, or microbic masses intercepted in the capillaries. *Pulmonary œdema* also occasionally occurs, especially in cases of bronchial croup, pulmonary congestion, and broncho-pneumonia. Oertel in his recent microscopic examinations of the lungs noted subpleural hemorrhages and hemorrhages extending to the alveoli, which were compressed. "Leucocytes infiltrated the alveolar septa, and in later stages invaded the alveoli, the epithelium of which became detached, and the characters of catarrhal pneumonia were thus produced. Some alveoli contained fibrinous exudation, and in one severe case the alveolar contents consisted of nuclei which exhibited disintegrating changes somewhat like those in necrobiosis."

Lymphatic Glands.—Enlargement of the cervical and submaxillary glands is of common occurrence in diphtheria, and it is a diagnostic symptom of some value. Hyperplasia of the cells of these glands occurs, with numerous hemorrhagic points in their capsules and in the periglandular tissue. Points of necrobiosis, staining faintly, occur in the glands, more in the cortical than in the central portions. The cells exhibit evidences of disintegration, and when this process is advanced granular masses form in the affected foci. Hyaline degeneration is also observed in portions of the glandular tissue, a degeneration common in other organs in diphtheria. Where disintegration is not too far advanced cells with polymorphous nuclei are observed—evidence of an active hyperplasia. Hyperplasia with points of hemorrhagic extravasation takes place also in the bronchial glands, but fewer points of necrobiosis occur than in the cervical and submaxillary glands, and these chiefly in the follicles. The lymph-ducts may contain no normal cells, and only those which have disintegrated nuclei along with other products of disintegration.

Heart.—The state of the heart will be in part described in our remarks relating to cardiac paralysis. Small extravasations of blood under the pericardial, and less frequently the endocardial, surface have been observed. Oertel attributes these hemorrhages to changes in the walls of the vessels caused by the diphtheritic virus, and Buhl, to nuclear proliferation in the walls and mechanical obstruction. Leucocytes in masses often occur under the pericardium and endocardium and between the muscular fibres. Sometimes the muscle-nuclei have undergone segmentation and degenerative changes. These nuclear changes occur mostly in fibres under the endocardium and around the coronary arteries. The nuclei in the muscular coat of the arteries are increased in size, and slight proliferation and desquamation of the endothelia and infiltration of the adventitia also take place.

Mouth, Stomach, Intestines.—The diphtheritic pellicle sometimes forms in the cavity of the mouth, generally in small patches; but the buccal surface is usually only superficially involved, except upon the tongue, where the pellicle extends more deeply. I have elsewhere stated that the diphtheritic exudate sometimes occurs upon the surface of the stomach and portions of the intestines, producing more or less destruction of the mucous membrane. Necrobiotic foci have been observed by Bizzozero and Oertel in the intestinal follicles and agminate glands, but to a less extent than upon the respiratory surfaces. Active cell-proliferation and disintegration and cleavage of nuclei occur, but these altered cells are mixed with others which are normal. The epithelium is for the most part retained and normal, and hyaline changes have not been observed in the gastro-intestinal vessels. The mesenteric glands sometimes undergo enlargement from hyperplasia, especially when the intestines are affected and points of necrobiosis occur in them. For the most part, however, the gastro-intestinal surface is less frequently affected than other mucous surfaces.

Spleen.—The diphtheritic virus reaches this organ through the blood-current. The spleen is swollen, so as to render its capsule tense. The pulp is soft, rising up through the cut surface of the capsule; the follicles are large and prominent; in the pulp are extravasations of blood and hæmatoidin masses, and the vessels are distended. Hyperplasia of the splenic corpuscles occurs, which is most marked around the bifurcations of the arteries, so that the reticulum is less prominent. The follicles are surrounded by a wide zone of the reticulated cells, among which we find lymphatic corpuscles, leucocytes, and large round cells. The nuclei in the cells undergo two changes: first, direct segmentation as in ordinary cell-division, and fragmentation, in which the chromatin is broken up in small, irregularly-disposed masses and the nuclear juice is susceptible of staining. In the Malpighian follicles either numerous epithelioid cells form, as mentioned by Stilling,[1] or large cells occur. The latter stain better by coloring reagents than the epithelioid cells, but less than the leucocytes. The epithelioid cells occur mostly in young patients.

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[1] *Virchow's Archiv*, Bd. ciii.

A wide zone of leucocytes surrounds and invades the follicles. The necrobiotic process also occurs as in other organs, beginning with nuclear disintegration, and when at its maximum the follicles are surrounded and loaded with the altered nuclei furnished by the round or epithelioid cells. Hemorrhages also occur in the follicles. In some protracted cases the vessels of the pulp exhibit the hyaline degeneration.

Liver.—Capillary hemorrhages take place within the capsule, and occasionally within the parenchyma. Leucocytes occur at certain points within the liver, infiltrating the tissue of the organ. They occupy the interlobular spaces and do not exhibit nuclear changes. The hepatic cells are unchanged or they become fatty.

Kidneys.—Albuminuria occurs from different causes, as we have stated elsewhere. Feeble heart-action, obstructed respiration, fever, and the direct irritating action of the diphtheritic virus upon the blood and the kidneys, are sufficient causes. The kidneys may be normal in cases of albuminuria, or exhibit different degrees of parenchymatous inflammation. Hemorrhages, glomerulitis, and disseminated nephritis are common lesions observed in the kidneys in those who have died having diphtheritic albuminuria. Hemorrhagic points occur not only under the capsule, but also in the glomeruli and in and between the tubules. Cell-infiltration takes place around the vessels and the cells exhibit nuclear disintegration. On examining the glomeruli, thickening of Bowman's capsule is sometimes observed, with some albuminous exudation underneath it, and epithelial proliferation and desquamation. The nuclei and endothelia of the glomerular capillaries are increased, and the chromatin and nuclear juice have undergone disintegrating and degenerative changes—results of inflammation. The capillaries are therefore in a degree diseased through the action of the blood-poison. The epithelium of the convoluted and straight tubes is also diseased. The epithelial cells, undergoing cloudy swelling, become detached from the basement membrane, fill the lumina with the necrosed product, and some of them escape, forming casts in the urine. Occasionally only the outer portion of the cell is necrosed and detached, the part adjacent to the basement membrane containing the nucleus remaining *in situ*. Oertel says that when the entire cells are thrown off granular casts are formed, but if only the outer portions are lost hyaline casts are produced. The collecting tubes, filled with granular masses containing broken nuclei, cells, and epithelia, may be dilated.

The above description of the anatomical changes which occur in the various organs is for the most part a résumé of the recent investigations by Oertel. Whether his published statement will be fully sustained by subsequent microscopic examinations remains to be seen.

SYMPTOMS.—Diphtheria, like scarlet fever, varies greatly in severity, from a form so mild that medical advice is not sought and the child is not even confined to his home, to a form so severe that the system is at once overpowered and the patient is in a critical state from the first. In general in the commencement of an epidemic the symptoms are more severe than when the epidemic influence is abating. During the continuance of the attack the prominent symptoms, such as arrest attention, are often disproportionate to the gravity of the attack. Striking cases illustrative of this fact have occurred in my practice, the friends not supposing that there was any serious ailment, and not seeking medical advice until the fatal termination was near.

In *benign* diphtheria the initial symptoms are often slight, such as languor or lassitude, slight chilliness succeeded by fever of a light form, mild headache, pain or aching in the body or limbs, thirst, and impaired appetite. Usually some soreness of the throat is noticed in swallowing, after the attack begins, and this continues. But the patient with mild diphtheria often continues to walk about, in the belief that he is affected with a slight and temporary ailment. Children with mild diphtheria in the poorer families are usually allowed to go abroad, and do great harm by propagating the disease. The symptoms in these mild cases so closely resemble those from a severe cold that the disease is liable to be mistaken for it. The slight tenderness or sensation of fulness in the fauces usually experienced by those old enough to express their sensations should always lead to an examination of the fauces, when the character of the attack will frequently be apparent. A distinguished clergyman of the Pacific coast who fell a victim to this disease dreamed a few nights before he complained of his illness that his throat was cut. Doubtless the diphtheritic inflammation had already commenced, so that what seemed a forewarning had a natural explanation. So insidious was the commencement in this case that the disease had advanced beyond all hope of relief when medical advice was first sought.

Soon after the attack commences inspection of the fauces reveals redness of the tonsillar surface, and this extends until the entire fauces present an injected appearance. After the lapse of twelve to thirty-six hours, or even as late as forty-eight hours, from the commencement of the disease, the diphtheritic exudate begins to form over the tonsils, producing the characteristic pellicle. Before it forms we often observe a grayish color of the prominent part of the tonsils, produced by the infiltration of the mucous membrane, and even of the surface of the tonsils, with newly-formed cells. The exudate may appear as points, which coalesce, forming a patch, or as a pellicle, which soon becomes thicker and at the same time firm. Its anatomical characters are described elsewhere.

But in most cases, in all except of the mildest type, the initial symptoms are more severe than we have delineated above. The attack in the *ordinary* as well as *severe* form of diphtheria commences abruptly, like scarlet fever, without a premonitory stage and with pronounced symptoms from the first. The temperature rises to 102°, 103°, or even 104° F., with corresponding heat of surface, thirst, languor, loss or impairment of appetite, tenderness of throat, etc. Delirium as well as eclampsia may occur; but both are rare. The temperature ordinarily begins to fall after the second or third day in favorable cases, and often in those of a grave and fatal type. Subsequently to the third or fourth day the temperature is frequently but little elevated. The diphtheritic poison, when the system is fully under its influence, does not exhibit any marked tendency, like that of scarlet fever, to increase the animal heat. Even in profound and fatal diphtheritic blood-poisoning rapidly approaching an unfavorable termination the thermometer often indicates nearly the normal temperature, so that the inexperienced practitioner may be deceived by this fact in his prognosis. A continued elevation of temperature considerably above the normal should lead the physician to examine for some complication, perhaps nephritis.

The tongue is moist and slightly furred. Many patients vomit in the commencement; and if this symptom cease or be not repeated it is not of grave import; but vomiting occurring often, so that a considerable part of the food is rejected, is common in grave cases and is an unfavorable prognostic symptom. It frequently is due to uræmia. The appetite in severe cases is usually poor. Repugnance to food from loss of appetite and pain in swallowing characterize severe forms of the disease. There are no notable symptoms referable to the state of the intestines. The stools appear normal, except as they are changed by the medicines prescribed. In all cases except the mildest a rapid destruction of red corpuscles occurs and a relative increase of white corpuscles. Hence the anæmia, which is soon manifested by pallor of the surface, and which rapidly increases as the disease advances. The early loss of the tendon reflex has recently been brought to the notice of the profession. It often occurs as early as the first, second, or third day. It is fully treated of in our remarks relating to diphtheritic paralysis in subsequent pages. It is a symptom of diagnostic value. Diphtheritic inflammations have a marked tendency to produce hyperplasia, and consequent notable enlargement of the lymphatic glands in their immediate neighborhood. The poisonous and irritating products of the inflammation upon the surface taken up by the lymphatics and deposited in the adjacent glands produce in them tenderness, swelling, an increased afflux of arterial blood, and a rapid increase of the cellular elements. An inflammation both of the lymphatic ducts and glands arises, with more or less œdema and sometimes inflammation of the adjacent connective tissue. Suppuration of the glands and connective tissue, though it may occur, is much less frequent than in scarlet fever.

Temperature.—There is probably no other disease in which the thermometer furnishes so little aid to an understanding of the case as in this, since the degree of fever does not sustain any fixed relation to the amount of blood-poisoning. Malignant diphtheria with profound blood-poisoning and approaching a fatal termination may be almost apyretic, while a benign form of the disease with but little blood-poisoning may commence with considerable fever (102°, 103°, or 104° F.). Fever in diphtheria is rather a symptom of the inflammation than of the blood-poisoning. Considerable elevation of temperature in diphtheria usually indicates an active pharyngitis, tonsillitis, laryngo-tracheitis, bronchitis, pneumonia, or nephritis. Therefore, although the thermometer does not aid in determining the amount of blood-poisoning, it enables us to form an opinion in regard to the extent and severity of the inflammation which may be present. The thermometer is also useful when diphtheria occurs as a complication of another constitutional disease, as scarlet fever, measles, typhoid fever, since it indicates the severity of this disease.

Such is the clinical history of diphtheria as it usually occurs, its local manifestation being primarily upon the tonsillar portion of the fauces, and extending from the tonsils, when the case is severe, to the posterior surface of the fauces, over the anterior and posterior pillars, and to the uvula. The uvula, when it is involved, becomes greatly swollen, even two or three times its normal size, so as to lie upon the tongue, and, especially if it be covered by a pseudo-membrane, to fill up the space between the swollen tonsils and intercept the view of the posterior fauces. When the inflammation is intense and the pseudo-membrane has not yet formed or has been removed by solvent applications, the tonsillar portion of the fauces often presents a grayish appearance from infiltration of leucocytes. This infiltration, if so great as to obstruct the circulation, leads to necrosis; but, as we have stated elsewhere, the necrosis of the mucous membrane is more likely to occur when it is still covered by the pseudo-membrane, the pseudo-membrane and mucous surface being incorporated with each other and being detached together. The color of the pseudo-membrane, at first whitish or a grayish white, becomes in a few days, in severe cases, a yellowish brown by the action of the atmosphere and sometimes by extravasation of blood. If the membrane be abundant, it is likely to have in a few days a musty and offensive odor, due to commencing decomposition. The constant inhalation of the highly poisonous gases which result is detrimental to the patient, and they increase the danger of infection in others. However, with the use of disinfectants, now so commonly employed, the poisonous gaseous products of decomposition are not so common as in former times. Since the pseudo-membrane is incorporated with the mucous membrane and capillaries penetrate its under surface, forcie detachment of the pellicle is likely to give rise to hemorrhage. Hemor- age is always a bad prognostic sign. The duration of the pseudo-membrane very variable. On the average in favorable cases it is from one to two weeks. There are cases, however, in which the ulcerated surface is long in ealing, and the ulcers are covered many days with the grayish-white diphtheritic exudate. In exceptional cases, at the close of the third or even ourth week we occasionally observe on the faucial surface diphtheritic atches two or three lines in diameter, without surrounding inflammation, n those who consider themselves nearly well and who would appear in the streets if they were allowed to do so. We will consider elsewhere how long enforced seclusion of the patient should be enjoined in order to prevent the propagation of the disease to others.

Nares.—Usually inflammation of the nostrils occurring in diphtheria is secondary to that of the pharynx. The pharyngitis has continued one or more days when a discharge of a thin serous appearance occurs from the nostrils. This is attended by swelling of the Schneiderian membrane; and in proportion to the amount of swelling the respiration through the nostrils is embarrassed. As the inflammation continues the swelling increases and respiration is accompanied by a nasal snuffle, or the occlusion of the nostrils is so great that it is performed entirely through the mouth. The impediment to respiration in infants at the breast, so as to necessitate spoon-feeding, we have alluded to above. The discharge is very acrid and irritating, causing excoriation around the entrance of the nostrils and even upon the cheeks. It soon becomes more viscid or less fluid than at first, and it presents a creamy appearance from the large proportion of pus-corpuscles. When the inflammation of the nares is severe, the glands around the articulation of the lower jaw usually undergo hyperplasia, becoming nodular and prominent, so as to be apparent not only to the touch, but also to the sight.

Although, commonly, diphtheritic inflammation of the nasal surface is secondary to that of the fauces, it is sometimes the primary inflammation. It may exist for some days before the fauces become affected, and under such circumstances the diagnosis is frequently not made until the disease is in an advanced stage and profound blood-poisoning has occurred. In nasal diphtheria the pseudo-membrane probably occurs as early as in other forms of diphtheritic inflammation, but being usually out of sight it is not observed in the first days or until it has extended so that its anterior edge can be seen on inspecting the nasal fossa. From its concealed position it is easy to perceive why the disease is so frequently overlooked, and a simple nasal catarrh is supposed to be present when there is no inflammation of the fauces to aid the diagnosis or it is late in appearing.

Nasal diphtheria always involves great danger, since it is very liable to give rise to systemic infection from the large number of lymphatics lodged in the connective tissue of the nares. In certain severe cases accompanied by swelling of the face there is reason to think that the inflammation has entered the antrum of Highmore—a very serious extension. It sometimes extends up the tear-duct, producing its occlusion, and also along the Eustachian tube. Hemorrhage sometimes occurs in nasal diphtheria. In those who recover the Schneiderian membrane returns slowly to its normal state.

The Eye.—We have stated above that the inflammation sometimes passes along the tear-duct to the conjunctiva, but in other instances the inflammation occurs independently of this mode of propagation. Thus, if a child with simple conjunctivitis contract diphtheria, the pre-existing inflammation is very liable to assume a diphtheritic character, in accordance with the law already stated, that diphtheria attacks by preference surfaces that are already inflamed. I have elsewhere stated that diphtheria at one time entered the ophthalmic wards of the New York Foundling Asylum, and three children, under treatment for granular lids, who contracted the disease, had diphtheritic inflammation of the lids, with the usual pseudo-membranous exudate. The result of diphtheritic conjunctivitis, even with prompt and appropriate treatment, is likely to be disastrous as regards the eye. The eyelids become red and greatly swollen from œdema, and their under surface is soon lined by a thick and firm pseudo-membrane. The eye itself is the seat of chemosis. The pseudo-membrane upon the ocular conjunctiva is less firm, not so thick, and more in flakes than that upon the palpebral conjunctiva. The eye affected by this disease should be closely watched and promptly and efficiently treated; but, unfortunately, under the most judicious treatment the cornea is likely to become hazy and sloughing or ulceration follow, with total destruction of sight and perhaps prolapse of the iris.

The Ear.—The ear may become inflamed by extension of the inflammation along the Eustachian tube from the fauces. The opening of this tube upon the faucial surface is small and slit-like in the child, and moderate inflammation and exudation are sufficient to close it. When this occurs the patient complains of pain in the site of the tube and in the ear. The formation of a membrane plugging the tube and the extension of the inflammation to the ear, producing an otitis media, add very much to the gravity of the case. Perforation of the drum, caries of the bones of the ear, and that grave disease otitis interna may occur, increasing very much the gravity of the case. Fortunately, this extension of the inflammation is not frequent. It does not often occur except in those malignant cases which are likely to be fatal from other causes. Sometimes, also, a diphtheritic otitis externa occurs. It is usually preceded by a catarrhal inflammation which has arisen from other causes and was present when the diphtheria commenced. Bezold described three cases of otitis externa with a diphtheritic pellicle upon the drum.[1] Moos and Callan have also narrated cases.

The Mouth.—During the progress of diphtheria any sore or abrasion of the mouth is likely to become the seat of the diphtheritic exudate. Usually the fauces, and sometimes the nares, are at the same time affected. The diphtheritic pellicle, commonly of small extent, may appear upon the inside of the cheek, the tongue, gums, and lips. Usually the inflammation of these parts is of secondary importance, but in malignant or highly septic cases it may be attended by considerable infiltration and thickening. Buccal diphtheria, if severe, is painful, and it may interfere with the proper nutrition. The clinical history of diphtheritic inflammation of the fauces and respiratory tract below the epiglottis is sufficiently presented elsewhere.

Œsophagus, Stomach, Intestines.—The upper part of the œsophagus not infrequently participates in the inflammation of the pharynx. Its walls are thickened, and the pseudo-membrane presents the same characters as upon the fauces. Occasionally, nearly the entire œsophagus is the seat of diphtheritic inflammation, the œsophageal walls being greatly thickened from infiltration of cells and very vascular. In one of the cases, related in a foregoing page, of diphtheria of the newly-born, the œsophagus was in nearly its entire length covered by the diphtheritic pseudo-membrane. In only one instance have I observed a severe diphtheritic gastritis. In this case nearly the entire surface of the stomach was covered by a thick pellicle. Probably the inflamed follicles did not secrete normal pepsin. A few cases are on record of diphtheritic inflammation of the intestines. Dr. A. Jacobi relates the case of a child of three years who had diphtheritic enteritis. Fever, moderate tenderness of the abdomen with but little tympanitis, constipation, and great prostration, were the prominent symptoms. The autopsy revealed the presence of a diphtheritic inflammation in the jejunum and ileum, the membrane consisting of "a dense network with granular contents." The most marked case of diphtheritic intestinal inflammation which has come under my notice was that of a physician to whose case I have elsewhere referred. He lost his appetite, had fever, lost flesh and strength, had distress in the abdomen which raised the suspicion of a typhoid fever; but at the usual time for the termination of a self-limited fever no abatement of symptoms occurred. Finally, after weeks of suffering, he expelled a cast of the intestine several inches in length, probably from the colon. Obstinate constipation was the most prominent symptom during this time and subsequently, due probably to cicatrization and contraction of the intestine. The patient died from the effects of the disease several months subsequently, having suffered constantly from faulty digestion, abdominal pain, and constipation, which no treatment could relieve or benefit.

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[1] *Virchow's Archiv*, lxx. 329.

Genito-Urinary Organs.—Diphtheria of the prepuce commonly occurs after some injury. It either arises by direct inoculation upon an abrasion or wound, or is contracted by exposure to an infected atmosphere. Many cases are on record. I have elsewhere stated that the eminent surgeon M. Germain Sée, whose practice is in a locality where diphtheria is endemic and very prevalent, now recommends stretching of the prepuce in nearly all cases of narrow and adherent prepuce, rather than circumcision, for the reason, among others, that diphtheria is more liable to follow the latter operation. Diphtheria of the prepuce is contracted by the use of infected instruments, sponges, or fingers in the operation of circumcision, or by the performance of the operation with clean instruments and hands, but in an infected atmosphere. Thus, Dr. F. Langé saw a case of preputial and scrotal diphtheria in a child of three weeks who had been circumcised when diphtheria was occurring in the family.[1] Dr. Greves states that a boy who had been circumcised for phimosis was admitted into the Liverpool Infirmary with an unhealthy prepuce which had never healed after the operation. Weak and anæmic when admitted, he continued to sink, and died of heart-failure. The wound and subjacent tissues were infiltrated with micrococci presenting the same characters as those in pharyngeal pseudo-membranes. In a preceding page I have alluded to a case, related by Mr. Phillips, of preputial diphtheria occurring after circumcision by infected instruments, and have related a case in my own practice of a severe diphtheria of the prepuce, and simultaneously of the fauces, occurring after instrumental dilatation of the foreskin. Dr. A. Jacobi states that he incised the upper part of the prepuce in a healthy boy of three years, employed stitches, and applied carbolized dressing. On the following day diphtheria attacked the wound, with the usual swelling and erysipelatous appearance. The stitches were removed, but death occurred four days after the operation. Dr. A. Jacobi also relates the case of a boy of four years whom he circumcised, and dressed the wound with antiseptic solutions. Diphtheria supervened, and in a few days the entire prepuce and a small portion of the penis became gangrenous. The boy eventually recovered, with deformity of the organ.

Billroth has called attention to the fact that diphtheria in localities where it is prevailing is likely to attack wounds produced by operations on the urinary apparatus, as after lithotomy or urethrotomy, and in cases of ectopia vesicæ and vesico-vaginal fistula. The inflammation under such circumstances is usually localized, but it may extend to the retro-peritoneal connective tissue and produce a fatal peritonitis. The marked liability of the uterus, vagina, and vulva when wounded in any way, as in parturition, to become the seat of diphtheritic inflammation in case of exposure to the infection, is well known to the profession, and no prudent obstetrician will attend an obstetrical case after visiting a diphtheritic patient without change of apparel and personal disinfection. Some years ago I was summoned to a young lady who during the week following her confinement insisted on seeing her child, then in the commencement of diphtheria. The child was brought to her bedside for a moment. Within a day or two she was attacked with a violent form of metro-peritonitis, which was speedily fatal. In children diphtheritic vulvitis and vaginitis occasionally occur, associated or not with pharyngitis. I. Zit has records of thirteen cases of diphtheritic vulvitis, in some of which inflammation was the first manifestation of diphtheria. Diphtheritic inflammation of the vulva and vagina is believed to be rare without a pre-existing catarrhal inflammation.

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[1] *Medical Record*, July 10, 1880.

Skin—An efflorescence is sometimes observed upon the skin during the time in which the temperature is exalted. It is the *erythema fugax* of dermatologists suddenly appearing and disappearing. This eruption, which is common in febrile and inflammatory affections of childhood, does not seem to present any peculiar characters in diphtheria. But there is another eruption which I have not infrequently observed, and which is attributable to diphtheritic toxæmia or septicæmia. It appears after the sixth or seventh day in the form of red points or spots not more than a line in diameter, and interspersed with patches of efflorescence with irregular margins, one to two inches in diameter. This roseolar eruption is slightly raised, like that of measles. Sometimes it is punctate. It disappears on pressure, and in my practice it has usually appeared in grave cases in which there were other evidences of blood-poisoning. Occasionally extravasations of blood occur in and under the skin, like those in internal organs. The pallor of the skin which diphtheritic anæmia and toxæmia produce in and after the second week is known to all who have had experience with this disease.

The anatomical characters and symptoms pertaining to the nervous system and kidneys will be treated of at length in our remarks on Albuminuria and Paralysis. Albuminuria and paralysis, whether we regard them as symptoms, complications, or sequelæ, occur so frequently and are of such grave import that it is proper to treat of them at length. They are the most important of the phenomena pertaining to the symptomatology of diphtheria.

ALBUMINURIA.

It is perhaps remarkable that numerous epidemics of diphtheria had been observed before it became known that albuminuria is a common accompaniment of it. The fact that the kidneys are affected so as to give rise to albuminous urine was discovered by Mr. Wade of Birmingham, England, in 1857. The interesting paper communicating his discovery was published in the *Midland Quarterly Journal of Medicine*, 1857. Immediately after its appearance the subject to which he drew attention was fully investigated in different countries, and in the same year Mr. James published his observations in the *Medical Times and Gazette*. In the following year (1858) two noteworthy papers appeared on the same subject, one by MM. Bouchut and Empis, read before the Parisian Academy of Sciences and published in the *Gazette des Hôpitaux*, and another by Germain Sée, and read before the Société des Hôpitaux. Since 1858 monographs and reports of cases too numerous to mention have been published, so that the literature of diphtheritic albuminuria is quite full.

As to the frequency of albuminuria in diphtheria, Bouchut and Empis found it in two-thirds of their cases, Germain Sée in one-half of his, and anné in 224 cases out of 410. In New York City, where diphtheria has een many years naturalized or endemic, I made in the years 1875 and 1876 aily examinations of the urine in 62 consecutive cases, and found it present n 24, while 38 were recorded exempt. But the proportion of cases as tated in my statistics is probably below the truth, for the albuminuria is sometimes transient, and it often occurs as a mere trace and is liable to be overlooked. Its duration is frequently not more than from one to three days, and in the majority of instances it does not continue longer than ten days; but we are all familiar with cases in which it continues fifteen or twenty days, or even for months.

The date of the commencement of albuminuria varies greatly in different cases. Perhaps the largest number of observations bearing on this point are those of Sanné. In 224 cases albuminuria was detected on the first day of diphtheria in 3, on the second day in 10, on the third day in 30, on the fourth day in 30, on the fifth day in 22. From the sixth day to the eleventh the number on each day in whom albuminuria was present for the first time varied from 10 to 33. After the eleventh day there were only 9 new cases, and after the fifteenth day only 1 new case. Hence from these statistics we infer that there is little danger that albuminuria will occur after the second week if the patient have exhibited no symptoms of it previously.

The amount of albumen in the urine varies greatly in different patients, from a slight cloudiness, scarcely visible after boiling, to so large a quantity that it becomes semi-solid by the application of heat or nitric acid. When the proportion of albumen is very large, there is also usually a notable diminution in the quantity of urine passed. In ordinary cases the percentage of albumen varies at different times. It sometimes disappears during one or two days, and we are led to think that the patient is rapidly recovering, but its reappearance in full quantity shows that the apparent improvement was due to some transient cause. "Nothing," says Sanné, "is more irregular than the course of diphtheritic albuminuria. At one time the precipitate is sudden, abundant, and flocculent; at another it commences with an opaque cloud, and continues with this characteristic till the time at which it disappears." Diphtheritic albuminuria differs in many respects from that in scarlet fever. The urine at first, when the renal disease is active, sometimes presents a pinkish tinge, and the microscope reveals the presence of red blood-corpuscles, but afterward, and in mild cases from the first, the urine exhibits nearly the normal appearance, even when very albuminous, in contradistinction to its cloudy appearance in scarlet fever. The specific gravity is low, falling to 1010 or less, and casts, both granular and hyaline, are present. When the kidneys are seriously implicated the quantity of urine is usually notably diminished. Great diminution is a serious symptom, and it often precedes the fatal issue.

In favorable cases the albuminuria does not in the average continue as long as in scarlet fever. The albumen may disappear from the urine in two or three days if its quantity has been small, and in a large proportion of cases it disappears within ten days; but cases occur in which albuminuria continues many months, with its final disappearance and the complete restoration of the health. Thus, a boy of six years treated by me had nephritis following a very mild attack of diphtheria. His urine in the first weeks was deeply tinged by the presence of red blood-corpuscles, but its quantity was normal, as determined by daily examinations, and it contained nearly or quite the normal amount of urea. Its specific gravity was at or under 1010. After a time the blood-corpuscles disappeared, the urine when not heated had its normal appearance, its specific gravity became normal, and the granular casts at first present disappeared. The patient was uniformly cheerful, was free from fever, his appetite was good, and no subjective symptoms occurred to indicate renal disease. Nevertheless, after the lapse of ten months a little albumen was still present in the urine.

But the presence of albumen in the urine, if considerable, is an unfavorable prognostic sign. Sanné states that in 233 cases of diphtheria accompanied by albuminuria 142 died and 91 recovered. In 160 cases in which albuminuria was absent, 63 died and 97 recovered. The statistics of others correspond with those of Sanné, so that the fact may be considered established that a larger proportion of cases of diphtheria with albuminuria perish than of those without albuminuria. It does not follow necessarily from this that the affection of the kidneys which produces the albuminuria contributes to the fatal result, for albuminuria is more frequent in grave cases than in those of a mild type. The termination in death may be due, and often is largely due, to other causes than the renal disease.

Although severe and so-called malignant forms of diphtheria are more likely to be complicated by albuminuria than are mild forms of the disease, yet, as in scarlet fever, severe and fatal renal disease giving rise to albuminuria sometimes occurs in very mild cases of diphtheria. Several years ago I attended a child of six years with the following history: He had mild pharyngitis, with scarcely appreciable exudation and almost no constitutional disturbance. On the second day the patient seemed so nearly well that both the doctor and the intelligent grandmother who had charge of him did not think further medical attendance necessary. One week subsequently I was summoned to the child in haste on account of nearly complete suppression of urine. About one drachm was passed each time and at long intervals. This when heated became semi-solid. The late Prof. Austin Flint, who saw the case in consultation, and myself notified the family of the extreme gravity of the case and its approaching fatal termination—a prediction which was verified in forty-eight hours. In such rare cases, while the diphtheritic poison acts with great power upon the kidneys, producing a fatal nephritis, its influence is feebly felt in those tissues which are the usual seat of diphtheritic inflammation. Diphtheritic albuminuria is rarely attended by anasarca or by symptoms of uræmic poisoning. In 224 cases of diphtheritic albuminuria embraced in Sanné's statistics, dropsy occurred in only 7. Trousseau did not meet it oftener than in 1 case in 20. Its infrequency has been attributed to the fact that only one kidney or only portions of the kidneys have been affected, the sound portions performing sufficiently the excretory function.

Oertel says: "The albuminuria of diphtheria is referable to many causes, of which the virus circulating in the blood is only one. Cardiac failure, respiratory difficulty, the febrile process, are adequate for the production of this symptom. The kidneys in cases where albuminuria has been present may be quite normal, or, on the other hand, they may exhibit varying degrees of parenchymatous inflammation."[1] The two common causes appear to be passive congestion of the kidneys, as of other organs, occurring during the dyspnœa of croup or from heart-failure, the albumen escaping from the over-distended renal veins, and parenchymatous nephritis, in which the tubules contain detached and disintegrating epithelial cells. In parenchymatou nephritis granular casts are commonly present.

As regards prognosis, writers agree that diphtheritic albuminuria in itself does not tend to a fatal result in most cases, the unaffected portions of th kidneys, as stated above, being sufficient for the excretion of the deleteriou products, especially the urea, whose retention in the system would involv danger. Therefore Sanné says "that diphtheritic albuminuria is an epi phenomenon which in the vast majority of cases remains without influence upon the course of the disease." But cases do occur, as we have seen by the history related above, in which fatal albuminuria, or fatal nephritis producing albuminuria, does take place as a complication or sequel of diphtheria.

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[1] Synopsis of Oertel's monograph, London Lancet.

Unruh in 1881[1] expressed the opinion that the albuminuria of diphtheria results from a simple transudation. But more exact microscopic examinations show that it is only in cases of croupal asphyxia or heart-failure that that degree of passive renal congestion occurs which leads to a transudation of serum. When there is no obstructed respiration, and no marked weakness of the pulse, the albuminuria is a result and symptom of infectious nephritis. Prof. Bouchard[2] states that infectious nephritis, whatever the cause or source of the infection, is a parenchymatous nephritis. Says he: "The kidneys are sometimes augmented in volume and weight. Their capsule has the ordinary appearance and adherence. The cortical substance appears sometimes grayish, sometimes congested and sprinkled with whitish tracts. The medullary substance preserves its normal aspect. In kidneys thus changed microscopic pathological anatomy reveals integrity of the tubes of Henle, catarrhal change of the straight tubes, and to a considerable extent of the convoluted tubes. In the convoluted tubes the epithelial cells remaining in place are swollen and sodden together. The cellular mass is entirely granular. . . . . Not only are the convoluted tubes obstructed by granular cells, but they are filled in some points by colloid matter or by blood. The glomeruli appear healthy, but we have seen the glomerular capsule distended with blood. In another case Renaut has seen it distended by colloid matter." Brault[3] has observed in diphtheritic albuminuria intense congestion of the capillaries of the tubules and glomeruli, altered epithelial cells, and transuded blood-elements indicative of parenchymatous inflammation.

PARALYSIS.

Another very important symptom and sequel of diphtheria is paralysis. It has diagnostic and prognostic value. Writers in medicine prior to the sixteenth century were either ignorant of diphtheritic paralysis, or they vaguely alluded to it when they described the extreme debility which sometimes accompanies or follows diphtheria. No clear and certain allusion to it has been discovered in medical literature until near the close of the sixteenth century. According to Sanné, Nicholas Lepois referred to it in 1580, and Miguel Heredia in 1690. Ghisi, in a letter describing the epidemic which occurred in Cremona on the north bank of the river Po in 1747–48, writes of his own son, who had paralysis in a severe form following diphtheria, "I left to nature the cure of the strange consequences, ... which had been remarked in many who had already recovered, and which had continued for about a month after recovery from the sore throat and abscess. During this period this child spoke through the nose, and food, particularly that which was least solid, returned through the nares in place of passing down the gullet." In France also diphtheritic paralysis began to attract attention at or about the time when Ghisi in Italy wrote the above. Chomel in 1748 described two cases, following what he designated gangrenous sore throat. The first patient, he says, had not quite commenced convalescence at the forty-fifth day of the disease, having still difficulty in articulating, speaking through the nose, and having the uvula pendulous. In the second case the patient became squint-eyed and deformed, but day by day as his strength returned he regained his natural appearance.

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[1] *Jahrb. für Kinderheilk.*

[2] *Revue de Médecine*, 1881.

[3] *Jour. d'Anat. et de Phys.*, Nov., 1880.

In America, in 1771, Dr. Samuel Bard of New York also related a case of this form of paralysis: A girl of two and a half years had recovered from a diphtheritic sore throat, and a diphtheritic pseudo-membrane upon the skin following the application of a blister had disappeared, when her convalescence was retarded by paralytic symptoms. "Whenever," says Bard, "she attempted to drink she was seized with a fit of coughing, yet she was able to swallow solid food without any difficulty. She improved, but in the second month she could scarcely walk or raise her voice above a whisper."

From the time of Chomel, Ghisi, and Bard more than half a century elapsed during which diphtheritic paralysis attracted little attention, though Jurine and Albers alluded to it in 1809. It cannot be doubted that cases occurred in this long period wherever diphtheria prevailed, but it might have been of such a type that the paralysis was infrequent, for Bretonneau, although he was familiar with Ghisi's and Bard's writings, did not recollect that he had seen a case of diphtheritic paralysis prior to 1843. Although a close observer of diphtheria, the paralysis had not been observed by him, or at least had not attracted his attention, until it occurred in the person of his townsman, Dr. Turpin, in 1843. Twelve years subsequently, in 1855, Bretonneau had made a sufficient number of observations to convince him that diphtheria frequently gave rise to a peculiar form of paralysis, and in his writings of this year he called the attention of physicians to this fact. But the opinions expressed by the eminent physician of Tours did not gain general acceptance until his friend and admirer Trousseau, at first distrustful of the existence of such a paralysis, had made a series of observations which fully established in his mind the theory of Bretonneau. His remarks on this subject, published in his *Treatise on Clinical Medicine*, are interesting, as showing how gradually important truths are revealed in medicine. He had seen as far back as 1833 a marked case in the service of Récamier in the Hôtel-Dieu, and another equally severe and typical case in 1846, but it was a long time before he recognized this ailment as one of the effects of the diphtheritic poison. Says he, speaking of the cases seen in 1833 and 1846: "They were a dead letter to me, yet I was acquainted with the case described by Dr. Turpin of Tours. Bretonneau related it to me, and said that it was a case of diphtheritic paralysis. The statement seemed to me incredible. I refused to see anything more in the case than a coincidence. . . . . It was not till about the year 1852 that, enlightened by new cases better studied and better interpreted, I understood diphtheritic paralysis as Bretonneau understood it. From this time, whenever an opportunity occurred, I in my turn called the attention of my colleagues to this important subject." The clinical teachings and observations of Bretonneau and Trousseau were widely read, and the profession throughout the world soon recognized the fact that diphtheria often gives rise to a form of paralysis which, if not peculiar to it, is yet rare in other infectious diseases. Since these observations of Trousseau were published many observations have been made and many monographs on diphtheritic paralysis have been written by such men as Roger, Germain Sée, Herman Weber, Charcot and Vulpian, Gubler, Landouzy, Suss, H. von Ziemssen, A. Jacobi, and W. H. Thomson. But the nature of the paralysis and the manner in which it occurs are still undetermined. The fact that there is such a paralysis was slow in gaining acceptance in the minds of physicians, and so the cause and pathology of the paralysis are still not fully ascertained.

CLINICAL HISTORY.—The statistics of different writers vary in regard to the frequency of diphtheritic paralysis. Probably it is different in different epidemics, and some observers may overlook the milder cases, which soon recover, and which are indicated by a slight impediment in swallowing and a revealed the presence of a diphtheritic inflammation in the jejunum and ileum, the membrane consisting of "a dense network with granular contents." The most marked case of diphtheritic intestinal inflammation which has come under my notice was that of a physician to whose case I have elsewhere referred. He lost his appetite, had fever, lost flesh and strength, had distress in the abdomen which raised the suspicion of a typhoid fever; but at the usual time for the termination of a self-limited fever no abatement of symptoms occurred. Finally, after weeks of suffering, he expelled a cast of the intestine several inches in length, probably from the colon. Obstinate constipation was the most prominent symptom during this time and subsequently, due probably to cicatrization and contraction of the intestine. The patient died from the effects of the disease several months subsequently, having suffered constantly from faulty digestion, abdominal pain, and constipation, which no treatment could relieve or benefit.

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[1] *Medical Record*, July 10, 1880.

Certainly, such remarkable cases should have been more minutely examined. It is remarkable, inasmuch as diphtheria is so widely spread and so closely studied, that if paralysis is sometimes the only manifestation of the operation of the diphtheritic poison, other similar cases have not been observed and reported. It is, in my opinion, more probable that in the above cases diphtheria had occurred of so mild a form that it escaped notice. I have related elsewhere a case in which diphtheritic albuminuria was preceded by diphtheria of so mild a form as regarded the usual manifestations that it nearly escaped detection, and yet the renal complication or sequel was so severe that death resulted. In another instance a little girl, not complaining of herself, left a call for a visit to her brother, whom I found with diphtheria of rather a severe type. At the time of my visit she was playing with other children in the street, and it occurred to me to call her in and examine her throat. To the surprise of the family, the characteristic diphtheritic patch was observed over one tonsil. Such mild walking cases are not infrequent in New York City, where diphtheria, established for many years, is constantly present, sometimes pernicious and speedily fatal, but in other instances having a type at the extreme of mildness and with no evidence of blood-poisoning. All physicians who have had much experience with diphtheria, as in localities where it is naturalized or endemic, can recall cases in which a sequel of diphtheria, such as paralysis or albuminuria, has led to an accurate diagnosis of a pre-existing throat affection which was so mild that its true nature was not suspected. In this respect diphtheria resembles scarlet fever, which also presents an equally variable type from extreme mildness to a fatal severity. Hence it seems probable that in Boissarie's cases diphtheria of so mild a form that it escaped notice had preceded the paralytic manifestation.

The paralysis, as a rule, affects both motor and sensory nerves. Thus in paralysis of the velum and pharynx anæsthesia more or less marked occurs of the velum, the isthmus of the fauces, and the walls of the pharynx, in addition to the motor paralysis. In the more severe cases anæsthesia with absence of reflex action occurs not only over the entire pharynx, but also over the epiglottis. The combination of motor and sensory paralysis should be borne in mind in studying the cause and nature of the ailment. The muscles affected by diphtheritic paralysis atrophy as in other forms of paralysis. Dr. H. von Ziemssen[1] says that such marked atrophy does not occur in any other disease, except in acute poliomyelitis and saturnine paralysis.

The symptoms and course of diphtheritic paralysis vary according to its location and the muscles affected. Therefore we will sketch the clinical history of its various forms separately, beginning with that which is first in time, most frequent, and least dangerous:

1. **Loss of the Tendon Reflexes.**—In 1882, Dr. Buzzard made the observation that the knee-jerk is absent in cases of diphtheritic paralysis. Bernhard[2] stated that loss of knee-jerk may precede other nervous symptoms, or may occur without other symptoms indicating impairment of the nervous system. He also stated a fact, now generally admitted, that the loss of knee-jerk may have diagnostic value in indicating the diphtheritic nature of a pre-existing obscure disease. But the profession in this country had little knowledge of the loss of the tendon reflexes in diphtheria until Prof. R. L. McDonnell of the Montreal General Hospital read a paper on this subject before the Canada Medical Association, August 31, 1887, and published it in the *Medical News* of Philadelphia in the following October. Dr. McDonnell's observations relate to 18 cases of diphtheria admitted into the General Hospital. Of these 18 patients, 10 had loss of knee-jerk at the time of admission, while

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[1] *Klinische Vorträge*, 1887, No. iv.

[2] *Virchow's Archiv*, Bd. xcix.

in the remaining 8 it was present. The cases observed by the doctor were sufficient, he believed, to enable him to make the following statement: *Knee-jerk in many cases of diphtheria is absent from the very first day of the illness.* It is a noteworthy fact that in most of the cases detailed by McDonnell in which there was loss of the tendon reflex other forms of paralysis subsequently appeared.

Since the publication of Dr. McDonnell's paper many observations have been made confirmatory of his statement. At a meeting of the New York Clinical Society, held December 23, 1887, Dr. L. E. Holt exhibited a brother and sister of five and two years with multiple paralysis who had lost the knee-jerk, and the examination of one of them showed complete loss of the plantar reflex. Since the attention of the profession has been directed to the loss of the tendon reflexes, all observers admit that it is not only the earliest, but also the most frequent, of the paralytic symptoms, probably occurring in one-third to one-half of all cases under treatment. Dr. Angel Money, in a discussion before the London Clinical Society, September, 1887, stated that he had observed an initial increase of the knee-jerk preceding its abolition. Dr. H. von Ziemssen remarks that, while the tendon reflexes are so often lost, the cutaneous reflexes are frequently exaggerated.

The loss of the tendon reflexes, while, as we have stated, it is the first in time of the paralytic symptoms, appears also to have the longest duration. In cases of multiple paralysis it seems to be the last to disappear. Thus, Dr. McDonnell states that the loss of knee-jerk in a boy of fourteen years continued four months, and in his two sisters it was still present when all other symptoms of the disease had disappeared.

2. **Palatal Paralysis.**—With the exception of the loss of the tendon reflexes the most common form of diphtheritic paralysis is that in which the velum palati and muscles of the pharynx are affected. This form of paralysis is revealed by a nasal intonation of the voice, slow speech, snoring during sleep, difficult deglutition, and return of liquids through the nares. As the paralysis increases in severity and extent, and the palato-glossus and constrictor muscles of the pharynx become paralyzed, the difficulty in swallowing increases. The patient finds it necessary to throw his head backward in swallowing and to swallow slowly and in small amount. The food descends in the œsophagus by its weight, and with but little aid from the pharyngeal muscles. On examining the fauces we discover the velum relaxed and motionless, and the uvula, deprived of its tonicity, drops on the base of the tongue. On touching the uvula with the point of a pen or pencil it is found to be insensible, no reflex action occurring. Sensory paralysis occurs, as a rule, in typical cases, the patient experiencing no pain when the parts are pricked with a pin or other instrument. The fauces should be inspected and tested from day to day in order to determine the progress of the paralysis. In mild cases it may be limited to the velum and palate, but it frequently extends to the epiglottis and upper part of the larynx, so that in attempts to swallow portions of the food enter the larynx, exciting a cough. The affected muscles may regain their use in less than a week, but frequently from one to two months elapse before their function is restored.

Palatal paralysis terminates favorably with few exceptions, if the patients are otherwise in good condition, but if there be much prostration from the antecedent diphtheria and from the dysphagia, death may occur from inanition. Cadet de Gassicourt has cited two cases of death from this cause, although life was probably prolonged by feeding by means of an œsophageal tube introduced through the nostrils. Rarely, also, death has occurred from the descent of food into the air-passages and the plugging of a bronchus. Tardieu and Peter have each related a case of this mode of death. As a chief function of the velum palati is to close the posterior nasal fossæ during deglutition, food, especially if liquid, is liable to be returned through the nostrils until the function of the velum is restored.

3. **Multiple Paralysis.**—This form of paralysis is commonly preceded by loss of the tendon reflexes. In most instances it begins with loss of power in the muscles of the palate, but exceptions occur. Cases are reported in which the muscles of the eye, those of motion and of accommodation, are first paralyzed, the palatal muscles being unaffected or subsequently attacked. Trousseau has stated that in cutaneous diphtheria the first loss of muscular power is sometimes in the lower extremities instead of in the palate; and other observers have recorded cases in which multiple paralysis commenced in one or more of the extremities. Therefore the order of the paralytic seizures differs in different cases, and muscles are affected in one patient that escape in another. The degree of paralysis varies in different muscles. In some the loss of power is complete, while in others it is partial. When the lower extremities are entirely motionless the patient frequently has considerable use of the upper extremities.

Even in the severest cases many groups of muscles entirely escape. Therefore I prefer the term multiple paralysis to the term general paralysis employed by some writers to designate this form of the disease.

Trousssau speaks of what he designates the mutability of diphtheritic paralysis. He says the paralysis which occupies one limb disappears in this limb to manifest itself in another. "The numbness, for example, which the patient has been experiencing in one leg will suddenly cease, and become greater in the other leg. To-day the right hand will not give a dynamometric pressure of more than ten to twelve kilogrammes, and to-morrow its power will have augmented, while that of the left will have diminished; then the parts which were first affected are a second time attacked and become more affected." Even the dysphagia may vary on different days, as Cadet de Gassicourt has stated. He relates the case of a child of three and a half years in whom the velum palati suddenly resumed its function: the head, which had dropped from paralysis of the muscles of the neck, became erect, the patient was able to sit, and the upper extremities recovered their power, but the improvement was of short duration, the paralysis returning as at first. These sudden and unexplained variations in the degree of paralysis resemble, says Trousseau, the mutability of paralysis in hysteria. Among the most noteworthy of the paralyses resulting from diphtheria are those pertaining to the eye. The media and retina are unaffected, but the levator palpebræ, the muscles of accommodation, and the motor muscles of the eye are paralyzed in certain patients, so as to cause dropping of the eyelids, strabismus, and indistinct vision. In addition to the muscles already mentioned, various muscles of the trunk, of the neck, the sphincter ani, and the sphincter vesicæ are sometimes paralyzed, producing deformity and incontinence of urine and feces. The paralysis of the muscles of accommodation is usually such that patients become presbyopic, seeing distinctly distant, but not near, objects.

The muscles of the face are also occasionally paralyzed. Many observers have related cases of facial hemiplegia. When general paralysis of the facial muscles occurs—fortunately, a rare event—whatever the mental state, however great the excitement, the features are entirely devoid of expression; the aspect is dull and idiotic; the face is flabby and motionless; the lids and lips droop; saliva flows from the mouth; and speech is slow and difficult. At the same time, the mental faculties, though deprived of the usual mode of expression, are sound and active.

But the most accurate idea of the symptoms of multiple paralysis can be

the presence of a diphtheritic inflammation in the jejunum and ileum,
brane consisting of "a dense network with granular contents." The
rked case of diphtheritic intestinal inflammation which has come
y notice was that of a physician to whose case I have elsewhere
He lost his appetite, had fever, lost flesh and strength, had distress
bdomen which raised the suspicion of a typhoid fever; but at the
ne for the termination of a self-limited fever no abatement of symp-
urred. Finally, after weeks of suffering, he expelled a cast of the
several inches in length, probably from the colon. Obstinate con-
was the most prominent symptom during this time and subsequently,
ably to cicatrization and contraction of the intestine. The patient
the effects of the disease several months subsequently, having suf-
stantly from faulty digestion, abdominal pain, and constipation, which
nent could relieve or benefit.

to-Urinary Organs.—Diphtheria of the prepuce commonly occurs after
ry. It either arises by direct inoculation upon an abrasion or wound,
tracted by exposure to an infected atmosphere. Many cases are on
I have elsewhere stated that the eminent surgeon M. Germain Sée,
actice is in a locality where diphtheria is endemic and very prevalent,
mmends stretching of the prepuce in nearly all cases of narrow and
prepuce, rather than circumcision, for the reason, among others, that
ia is more liable to follow the latter operation. Diphtheria of the
is contracted by the use of infected instruments, sponges, or fingers
eration of circumcision, or by the performance of the operation with
truments and hands, but in an infected atmosphere. Thus, Dr. F.
w a case of preputial and scrotal diphtheria in a child of three weeks
been circumcised when diphtheria was occurring in the family.[1] Dr.
tates that a boy who had been circumcised for phimosis was admitted
Liverpool Infirmary with an unhealthy prepuce which had never
fter the operation. Weak and anæmic when admitted, he continued
and died of heart-failure. The wound and subjacent tissues were
l with micrococci presenting the same characters as those in pharyn-
udo-membranes. In a preceding page I have alluded to a case,
y Mr. Phillips, of preputial diphtheria occurring after circumcision
ed instruments, and have related a case in my own practice of a
phtheria of the prepuce, and simultaneously of the fauces, occurring
trumental dilatation of the foreskin. Dr. A. Jacobi states that he
he upper part of the prepuce in a healthy boy of three years,
l stitches, and applied carbolized dressing. On the following day
a attacked the wound, with the usual swelling and erysipelatous
ce. The stitches were removed, but death occurred four days after
tion. Dr. A. Jacobi also relates the case of a boy of four years
circumcised, and dressed the wound with antiseptic solutions.
ia supervened, and in a few days the entire prepuce and a small
f the penis became gangrenous. The boy eventually recovered,
ormity of the organ.

th has called attention to the fact that diphtheria in localities
is prevailing is likely to attack wounds produced by operations on
ry apparatus, as after lithotomy or urethrotomy, and in cases of
esicæ and vesico-vaginal fistula. The inflammation under such cir-
es is usually localized, but it may extend to the retro-peritoneal
e tissue and produce a fatal peritonitis. The marked liability of
s, vagina, and vulva when wounded in any way, as in parturition,
e the seat of diphtheritic inflammation in case of exposure to the

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[1] *Medical Record*, July 10, 1880.

changes. The pulse becomes feeble and abnormally slow or rapid—it is usually at first slow and subsequently rapid—the respiration is superficial and the surface becomes pallid, often slightly cyanotic. In the more favorable of these cases the patient may rally by active stimulation, and perhaps he eventually recovers, or after some hours or a day or two of comparative comfort he succumbs to a return of heart-failure. There is no other disease in which these sudden, unforeseen, and fatal attacks of heart-failure occur so frequently as in diphtheria. There is no other disease in which physicians are so frequently deceived in their prognosis for various reasons, but largely on account of the occurrence of these unexpected attacks of heart-weakness.

But a clear and accurate idea of the clinical history of these cases of sudden heart-failure can be best imparted by the relation of typical cases. For this purpose I will briefly narrate cases occurring in the hospital service of one of the most trustworthy clinical teachers of the present time, M. Cadet de Gassicourt, though I believe that all physicians who have been several years in practice where diphtheria is prevailing can recall to mind cases equally striking and typical. I select his cases on account of the completeness of his records:

A child of two years entered Cadet de Gassicourt's service on January 3d with diphtheritic pharyngitis of ten days' continuance. The tonsils were large, still covered with pseudo-membrane, and the submaxillary glands were also enlarged. He had no laryngeal symptoms and his urine was without albumen. On the following day the velum and pharyngeal muscles were slightly paralyzed, the speech nasal, and deglutition moderately embarrassed. He was quiet during the night of January 4th and in the morning of the 5th, but at ten A. M. he became chilly, his face and extremities feebly cyanotic, and slight dyspnœa and dilatation of the alæ nasi were observed. His pulse, at first abnormally slow, became rapid; he was agitated, uttered loud screams of distress, and fell back cyanotic and dead. The death-struggle did not occupy more than one minute. Another infant, also two years of age, entered the same service, having diphtheritic pharyngitis of two days' continuance. The fauces presented the usual red appearance, the tonsils were swollen and covered with a thick exudate, but there was no albuminuria nor croupiness. Two days later the pseudo-membrane had diminished, but the velum palati was paralyzed. On the following day the general appearance was satisfactory and the pseudo-membrane had still further diminished. At eight P. M. the infant was suddenly seized with vomiting, accompanied with great dyspnœa, rapid pulse (160), and a cyanotic hue of the face and extremities. He was restless and uttered cries of distress. Two hours later he screamed loudly, raised himself in bed, and fell back dead. A child of five years was admitted with diphtheritic pharyngitis of two days' continuance, having enlarged tonsils covered with pseudo-membrane, and enlarged cervical glands, but without cough or albuminuria. Seven days later, the ninth of the disease, the pseudo-membrane had disappeared, but the velum palati was paralyzed. On the following day there was little change, except occasional vomiting, but the general state was good and sleep tranquil. At seven A. M. on the following day, the eleventh of the disease, after a calm night, the child uttered two or three cries, the pulse became rapid, the respiration embarrassed, the features, extremities, and finally the entire surface, cyanotic, and at eight A. M. death occurred quietly.

The similarity of these three cases is apparent. Paralysis of the velum and palate had continued in the first case eighteen hours, in the second case thirty-six hours, and in the third case forty-eight hours, when suddenly the heart and lungs were greatly embarrassed in their functions, and death occurred within one hour from the commencement of the severe symptoms. Th gitation, repeated cries of distress, and the shrill cry that preceded death dicated extreme suffering.

Severe pain, præcordial, epigastric, or abdominal, is present in some if ot in most of these cases of sudden heart-failure, as we shall see from others resently to be related. It was probably experienced by these three patients, ho were too young to express clearly their subjective symptoms.

Gombault made a minute microscopic examination of the affected organs these three cases after the tissues had been properly hardened by chemical gents. In one of the cases he examined the pneumogastrics and myoardium, and both were found in their normal state. As regards the nervous entres, the anatomical changes were alike in all three. In the spinal cord esions were found at the origin of the anterior roots of the spinal nerves, characterized by fragmentation of the medullary substance in the nervefibres, numerous granules and minute globules appearing in this substance and occupying its place.

In addition to this, undue swelling of the axis-cylinders was observed. In the three cases the gray substance in the anterior cornua had undergone a sort of rarefaction, the microscopic sections being more transparent and the elements in the section being wider apart than in the normal state. No meningitis or injury of the blood-vessels was observed in the spinal columns, but numerous nerve-cells were deprived of their prolongations. The medulla oblongata, the centre and source of the nervous supply to the heart, lungs, nd stomach through the pneumogastrics, was also carefully examined in the hree cases. Nothing abnormal was observed in this organ, except small asses of leucocytes in the vessels. The substance of the medulla oblongata d the nerve-fibres constituting the roots of the pneumogastrics seemed lthy. The small masses of leucocytes in the blood-vessels were not ficient to obstruct the circulation, and the appearance of the blood-corcles was normal. Hence, in the opinion of Gombault, the small aggregas of leucocytes in the vessels had no effect on the innervation of the acic organs derived from the medulla. The points of special interest in microscopic examination of the three cases were the apparently healthy normal state of the pneumogastrics and myocardium in the one case in h they were examined, and of the medulla oblongata in the three cases, e the gray matter of the spinal cord, which has no immediate nerve-conion with the heart, showed marked degenerative changes.

The above are striking examples of sudden and fatal heart-failure occurduring apparent convalescence, when the symptoms of diphtheria ared to be abating, with the exception of the paralysis of the velum palate. The following cases presented a clinical history in some respects rent: A child of eight years had been under treatment for diphtheria e February 9, 1883. On February 20th the membrane had disappeared, slight paralysis of the velum and left upper extremity was observed and urine contained a little albumen. At three P. M. she was seized with ere abdominal pains, followed by vomiting, slow respiration, slow and ble but regular heart-beat, imperceptible pulse, coolness of surface, and nosis. These symptoms increased, and at half-past six P. M. death occurred. e clinical history differed from that in the three cases related above in the t that there was no agitation or moaning at the close of life, and that the art-beat remained abnormally slow unless during the last moments. In other case paralysis of the velum and palate began on the third day of phtheria, while the pharyngeal and nasal inflammations were in full activity. he urine was slightly albuminous. Three days subsequently, in the morng. the muscles of the nucha and right shoulder were paralyzed. At two P. M. the child complained of violent abdominal pains, followed by nausea and vomiting. The vomiting was partially relieved, but dyspnœa and a rapid heart-beat followed. The cyanosis increased until it extended over the entire surface, and death occurred three hours after the commencement of symptoms referable to heart-failure. A boy of five years had diphtheritic croup, for which tracheotomy was performed and the canula inserted. He subsequently did well for a time, but afterward lost his appetite. On the eleventh day of the disease he had paralysis of the velum and palate. On the twelfth and thirteenth days the disease seemed to be stationary and the child was quiet. Suddenly, at seven P. M. on the thirteenth day, multiple paralysis occurred. Liquid food taken by the mouth was returned in part through the nostrils, and a part entered the larynx and escaped from the tracheal opening. An hour later the muscles of the nucha, the arms, and both sides of the trunk were paralyzed and the head dropped. At seven A. M. on the following day vomiting, dyspnœa, cyanosis of the face and extremities, and a very rapid pulse occurred. The asphyxia increased, the pulse grew more feeble, the surface cool, and death took place three hours later.

Cases like the above are not infrequent in severe epidemics of diphtheria, but in some instances the loss of power in the heart occurs more gradually. A boy of twelve years had diphtheritic pharyngitis from which he was apparently convalescing. Some days after the disappearance of the inflammation the velum palati and muscles of the pharynx were paralyzed. Then succeeded paralysis of the muscles of the nucha, of the muscles of accommodation, and of those of the upper and lower extremities. The march of the paralysis was for a time progressive. Then it seemed to recede, but the improvement did not continue. One month from the commencement of diphtheria the child uttered plaintive cries, became motionless as if from general paralysis, and a state of asphyxia slowly occurred, accompanied by cyanosis. During the following night the patient lay in a stupor, and on the ensuing morning the features presented a cadaverous and slightly cyanotic hue, the extremities were cool and blue, the tongue pallid, moist, and of a normal warmth, the respiration hurried and without auscultatory signs of disease, the pulse feeble and rapid (148). Finally, the sphincters were paralyzed, the urine and feces escaping involuntarily. Within ten minutes after the above notes were written the patient died of heart-failure. The feature of special interest in this case was the long continuance of multiple paralysis when the cardiac and pulmonary symptoms occurred.

Sudden heart-failure in diphtheria is usually fatal, but recovery is possible. Cadet de Gassicourt in his large clinical experience met 1 recovery to 14 deaths. This case is interesting, since the heart-failure preceded the palatal and other forms of paralysis, instead of being preceded by them, as is ordinarily the case. Twenty days after the commencement of diphtheria, and when in apparent convalescence, the patient was seized with extreme pain in the præcordial region, attended by a fall of pulse to 42. He had cold sweats, rigors, and vomiting. In one and a half hours these symptoms abated. Three days subsequently another similar attack occurred, and subsequently two others, but less severe than the first. On the twenty-eighth day from the beginning of diphtheria and eight days after the syncopal attacks paralysis of the velum and pharynx began, soon followed by paralysis of the vocal cords, of the muscles of accommodation, and of those of the extremities, which continued three months, when recovery was complete. Cases of recovery from sudden and alarming symptoms of heart-failure have also been related by Sanné, Billard, and others.

What is the cause of this sudden loss of power in the heart in diphtheria, occurring usually during apparent convalescence? Does it result from disease in the muscular structure of the heart, from thrombosis or ante-mortem

cavities of the heart, or does it result from disease of the central
nervation, the medulla oblongata, or from disease and deficient
power in the important nerve which controls the heart's action,
gastric, or in the branches which this nerve supplies to the heart
he lungs and the stomach?—for these three organs appear in most
o be affected simultaneously.

t and Lagrave attribute sudden heart-failure in diphtheria to
s; and yet it is very seldom that a *bruit* or heart-signs indicative
ditis have been observed during life. The belief in the ocurrence
mmation is based on the appearance of the free edge of the mitral
sometimes of the aortic valves in addition. They have appeared
as if from the presence of minute vegetations. At the same time,
of the valves and the endocardial surface have undergone no
change, such as an endocarditis would be likely to cause. Since
cement of the theory of Bouchut and Lagrave and attention has
n to the subject, the roughened edge of the mitral and aortic
n which their theory of an endocarditis as the causal agent
heart-failure is based, has been found with equal frequency in
ho have perished with other diseases. The late Prof. Parrot says
assicourt expressed the decided conviction that the roughening
of these valves does not have an inflammatory origin, but is
cal peculiarity which originates in the fœtal development. Sanné
erence to Bouchut and Lagrave's theory, "My personal investi-
absolutely negative. Observations of diphtheria to the number
en in these later years, ... have not furnished a single case of
s. I should fear to express myself in such a positive manner
trust to the simple testimony of my senses; but a large number
tients were auscultated by Barthez and by D'Espine and Gom-
. The conclusion . . . . therefore is that diphtheritic endocar-
remely rare, as pathological anatomy and clinical observation alike
e." Therefore the theory which attributed sudden heart-failure
ditis has not been sustained by recent observations, and does not
e tenable.

ing of the heart's action in diphtheria, with sudden death as a
e, has with more probability been attributed to granulo-fatty
n in the muscular fibres of the heart consequent upon a prolonged
diphtheritic attack. Oertel says: "When the general disease lasts
very intense, and especially in cases in which death is caused sud-
ralysis of the heart, the muscle appears pale, soft, friable, broken
ations of blood, and on microscopical examination most of its fibres
be already in an advanced stage of fatty degeneration."[1] Such
e changes, if occurring in a considerable proportion of the muscu-
the heart, would inevitably render the contractile power of this
e and perhaps inadequate. Still, if we regard it as a cause of
rt-failure, it can be regarded as such in only a relatively small
instances, for in most cases the weakening of the power of the
lden and during convalescence—at a period, therefore, when degen-
nges are not likely to occur. In most of the recorded cases the
power of the heart does not appear to have been notably weakened
the attack of heart-failure, as it would probably have been were
e changes in the myocardium the sole or chief cause. The clini-
is as if the heart were suddenly overpowered by an agent of rapid
w—development. Moreover, in typical cases of sudden heart-
microscope sometimes reveals a healthy myocardium, as in one

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[1] *Ziemssen's Cyclopædia*, vol. i.

of the cases related above. We must look, therefore, for some other cause, although admitting that degenerative changes in the muscular fibres of the heart, when present, contribute to a weakened action of this organ.

Sudden heart-failure in diphtheria has also been attributed to cardiac thrombosis; but, as several writers have pointed out, the heart-clots are identical in appearance and kind with those found in the heart after death from other diseases than diphtheria. There is every reason for the belief that they occur during the death-struggle, and therefore are not the primary cause of the heart-failure, but are secondary or consecutive.

Among the most strenuous advocates of the theory that cardiac thrombosis is the common cause of sudden heart-failure and sudden death in diphtheria is Dr. Beverly Robinson, now a distinguished physician of New York, whose able thesis on this subject, published in 1871 when he was a resident of Paris, attracted much attention and is alluded to by nearly all recent French writers on this subject. But the opinion of most pathologists in reference to this theory is, I think, expressed by Cadet de Gassicourt in the following passages, published in his clinical treatise: "I have often shown you these clots, and I have enabled you to see that they occur equally in children who have died of diphtheria as well as in those who have succumbed to other maladies, in subjects struck with sudden death, and in those who have not been attacked by any sudden casualty. This objection is in itself conclusive. You have been able to see also that the constitution of these clots does not have any of the characters which authors the most competent have assigned to clots formed during life: they are the clots of the agony." Sanné also writes in almost identical language.

In searching for the cause of sudden heart-failure in diphtheria we must note the fact that, as a rule, in typical cases it is preceded by palatal and often multiple paralysis. The paralysis has continued for a time, extending perhaps from one group of muscles to another, when suddenly the heart passes under some powerful influence which restricts and overpowers its action. The theory of deficient innervation or a true cardiac paralysis appears most tenable under the circumstances. It affords the most satisfactory explanation of those unfortunately not infrequent cases in which death suddenly occurs during apparent convalescence from diphtheria, when the symptoms are fast disappearing, with the exception of the palatal or other paralysis. It affords best of all the theories an explanation of the occurrence of sudden death from heart-weakness in those obscure cases which have puzzled physicians—cases in which the post-mortem examination has revealed an apparently healthy state of the heart. The theory of an arrested or deficient innervation of the heart also furnishes an explanation of the occurrence of concomitant symptoms in these cases of sudden heart-failure—such symptoms as vomiting, epigastric pain, and dyspnœa or irregular respiration; for the heart derives its innervation from the same source as the lungs and the stomach—that is, through the pneumogastric. For the reasons now given we feel justified, in our classification of the forms of diphtheritic paralysis, to make a distinct class having the designation cardiac paralysis, or, to adopt in our language the French expression, cardio-pulmonary paralysis.

ETIOLOGY.—The four forms of diphtheritic paralysis—first, the abolition of the tendon reflexes, the most common, the earliest, and the least dangerous of all; secondly, palatal paralysis, which may occur as early as the third day of diphtheria, but is most common during its later stages, or in the period of convalescence; thirdly, multiple paralysis, in which various muscles throughout the system are paralyzed; and, fourthly, cardiac paralysis, the most dangerous of all—probably are produced by the same cause and have the same pathology in most instances. We may, therefore, in the following pages, in studying the cause and nature of diphtheritic paralysis, regard the various forms which it exhibits as manifestations of one disease. What is true of cardiac paralysis as regards its cause and nature we may assume to be true in reference to palatal and multiple paralysis, and even the abolition of the tendon reflexes. The most dangerous and fatal paralysis, the cardiac, is, as we have stated above, in nearly all patients associated with the milder forms, showing that the same cause or causes are operative at the same time in the individual.

Gubler, in his memoir published in 1860–61, attributed paralysis of the velum and palate to disease of the terminal nerves produced by contiguity or propagation from the inflamed fauces: and he held that the same injury of the nerves and paralysis might result from any anginose inflammation if severe enough. But this theory was short-lived, for physicians soon perceived that it was inadequate to explain the occurrence of paralysis at a distance from the inflamed surfaces; and palatal paralysis sometimes occurs after cutaneous and other forms of diphtheritic inflammation in which both the fauces and the nares have entirely escaped and remained healthy.

Trousseau, impressed with the inadequacy of Gubler's theory, directed his attention to the nervous centres. He was led to believe, from the fact that the paralysis usually terminates favorably, and because in certain fatal cases he was unable to discover any lesion sufficient to produce the paralysis in the brain, spinal cord, or meninges, that it did not occur from any structural change in the nervous system. Trousseau, an unsurpassed clinical observer, was not a microscopist, and being unable to discover any anatomical cause of the paralysis, he relates the case of the crew of a vessel who were paralyzed by eating an eel which contained some poisonous ingredient, and, after alluding to instances of paralysis resulting from smallpox, typhoid and typhus fevers, and cholera, continues: "Well, then, diphtheritic paralysis belongs to the same category: its real cause is the poisoning of the system by the morbific principle which generates the malady on which the paralysis depends, and in regard to the mode of action of which in producing the paralysis we shall always perhaps remain in ignorance."

Since the time of Trousseau many eminent pathologists have endeavored to discover the anatomical characters and elucidate the nature of diphtheritic paralysis by patient and thorough microscopic examinations. We have already detailed the microscopic appearance in Cadet de Gassicourt's three memorable cases. In 1862, Charcot and Vulpian stated that they had examined the nervous filaments in the velum palati paralyzed by diphtheria, and found certain of them entirely free from medullary matter, granular bodies occupying its place; but partial degeneration was more common. In some of the fibres the medullary matter was intact. Lionville in 1872 stated that he had found degenerative changes in the phrenic nerve of a patient who had died of asphyxia following an attack of diphtheria. The contents of certain of the fibres constituting this nerve were amorphous, filled with granular bodies instead of the normal nerve-substance. Leyden in 1872 discovered lesions in the peripheral nerves and in the central organ upon which he based his theory of an ascending neuritis. Roger and Damaschino in 1875 examined the nervous system in four children who had died of diphtheritic paralysis, and found atrophy of the nerve-fibres in the peripheral nerves. The medullary matter appeared granular in certain points, and in others it had entirely disappeared, while the axis-cylinder was not notably altered.

Such observations, to which others might be added, have fully established the fact of peripheral nerve-lesions, such as would be likely to result from a neuritis, in the paralysis of diphtheria; but it must be borne in mind that the various observers, while they report degenerative changes in certain of the nerve-fibres or tubes in the peripheral nerves of the paralyzed part, also state that others in the same nerves were to appearance normal and capable of performing their function. Such are the facts upon which the theory that diphtheritic paralysis is caused by peripheral nerve-lesions, a peripheral neuritis, is based.

In the endeavor to elucidate the cause of diphtheritic paralysis attention has also, as might be expected, been directed to the state of the brain and spinal cord, and anatomical changes have been discovered in them quite as marked as in the peripheral nerves. Buhl, Roger and Damaschino, Pierret, Vulpian, Déjerine, and Oertel discovered in different cases in the brain and spinal cord in those who died of paralysis various anatomical changes, among which we may mention small extravasations of blood and slight softening in the cerebral substance, extravasations of blood and thickening of the neurilemma in the roots of paralyzed nerves (Buhl); endo- and perineuritis at the point of origin of the affected nerves, thickening of the walls of the vessels and accumulation in them of white corpuscles (Pierret); rarefaction of the connective tissue and degenerative change in the nerve-cells in the anterior cornua of the cervical and upper dorsal region of the spinal cord (Vulpian); atrophy and granular degeneration and fragmentation of the myeline in the nerve-tubes in the anterior roots of the spinal nerve, increase of nuclei in the white substance of Schwann, disappearance of the axis-cylinder and slight fatty degeneration of the walls of the capillaries (Déjerine).

Déjerine in the microscopic examination of five cases of paralysis discovered anatomical alterations in the gray substance of the spinal cord, the white substance being intact. He observed in the gray substance cells atrophied or in process of atrophy, with the disappearance of their prolongations, so that healthy cells were comparatively infrequent. The cells seemed to have undergone the change which occurs in acute or subacute myelitis. The vessels in the gray substance were dilated and flexuose. They were in a state of hyperæmia or congestion, and at points small intestinal hemorrhages had occurred. Around the central canal and in the commissures the nuclei were increased. The white substance of the spinal cord presented the normal appearance. These anatomical changes in the cord apparently resulted from a myelitis. The spinal nerves whose roots originated in the diseased gray matter of the cord were found to have undergone a similar change in their peripheral distribution. Therefore in the five cases in which such minute examinations of the nervous system were made the lesions in the cord and the nerves were similar.

In 1883, Dr. E. Hyla Greves of Liverpool, pathologist to the Royal Infirmary, obtained permission to examine the spinal cord in a child of three years who had died of sudden heart-failure after having suffered from an aggravated form of multiple diphtheritic paralysis. She had had anæsthesia of the fauces and all her extremities, liquid food regurgitated through her nostrils and entered her larynx, she passed urine and feces in bed, she could not stand or sit without support, her head dropped helpless, her speech was indistinct, her tongue could not be protruded, her respiration was slow and shallow, her pulse 50 per minute and feeble, and she was nourished by enemata of pancreatized milk. The paralysis increased so that the diaphragm alone acted in respiration, the pulse became slower, irregular, and more feeble, and death occurred suddenly. At the autopsy, which was limited to the spinal cord, the veins of the lower part of the cord were much congested; the white substance of the cord presented the normal appearance to the naked eye, but the gray matter of the lumbar and lower dorsal regions was extensively softened, and in the left half of the cord diffluent, so as to flow from the section, leaving a cavity. Higher up in the cord the gray substance was hyperæmic, but not diffluent. The diffluent gray matter was unsuitable for microscopic examination, but other portions of the cord were examined, with the following result: Many ganglion-cells of the anterior cornua were destroyed or in the state of "cloudy swelling;" others had lost their processes and were reduced in size; increase in the number of nuclei in the neuroglia throughout the cord; gray substance in the right half of the cord in an early stage of softening; in the dorsal and cervical regions everywhere the ganglion-cells were in a state of "cloudy swelling." No appreciable change in the white matter of the cord. It is evident that this was an extreme and rare case of degenerative change in the cord, and one in which the paraplegia, had the patient lived, would have been permanent, for the diffluent gray matter in the cord could not have been restored to its normal integrity. It was not, therefore, an ordinary case, inasmuch as the paralyzed muscles, as a rule, recover their function in those who survive.

Such is a summary of the lesions, peripheral and central, in the nervous system which have been discovered in fatal cases of diphtheritic paralysis. We have presented the facts upon which the theory of the cause and nature of the disease must be based. Are we able to present a theory which will hold good in regard to cardiac paralysis characterized by sudden heart-failure, to pulmonary paralysis characterized by superficial or embarrassed respiration, to palatal and multiple paralyses with their many inconveniences, and to the loss of the tendon reflexes?

Must we, with Trousseau, rest satisfied with the belief that the manner in which diphtheria produces paralysis is beyond our comprehension and will probably never be known? Dr. Abram Jacobi, seeing the inadequacy of the various theories to explain all cases or forms of diphtheritic paralysis, wrote in 1880 as follows in his treatise on diphtheria: "It may be positively asserted that diphtheritic paralysis does not in every case depend on one and the same cause."

The theory which is most strongly advocated at the present time, and which appears to be accepted by a large proportion of the specialists in nervous diseases under the lead of Charcot, is, as we have stated above, that diphtheritic paralysis results from a peripheral neuritis. Others, observing central lesions in the nervous system, have naturally inferred that they have an important share in the production of the paralysis. It is very important that the practitioner when confronted by this grave malady should have a clear conception of its cause and nature, that he may be better able to apply the appropriate remedies. We will, therefore, examine with the light obtained from clinical experience the prevailing theory that diphtheritic paralysis results from anatomical changes, peripheral or central, or both, in the nervous system. Is this theory adequate to explain the paralysis as it commonly occurs? We will give a brief summary of the objections to it, at the risk of repeating what we have already stated:

1. Cases occur in which carefully-conducted microscopic examinations reveal an apparently normal state of the nerve supplying the paralyzed part and also of the nervous centre from which this nerve originates.

Thus, in the three cases of typical cardiac paralysis described above occurring in the practice of Cadet de Gassicourt, the pneumogastric and its branches examined in one case appeared normal, and no lesion sufficient to cause paralysis was found in a careful examination of the medulla oblongata, the central organ of innervation of the heart.

2. Palatal paralysis sometimes occurs as early as the second or third day of diphtheria, and loss of the tendon reflexes as early as the first day. Can

we believe that a peripheral neuritis or anatomical changes in the cerebro-spinal axis have occurred at so early a date, so as to cause the paralysis?

3. In its commencement diphtheritic paralysis often exhibits what Trousseau designates mutability. It suddenly shifts from one group of muscles to another. Muscles paralyzed on one day have their normal action on the following day, while other muscles are attacked, and on the third day the group of muscles first attacked are perhaps again paralyzed. This mutability of the paralysis, this sudden shifting from one group of muscles to another, militates strongly against the theory that the cause of the paralysis is a structural change in the nervous system, whether cerebral or peripheral. It would seem impossible that there should be a sudden recovery from the paralysis, and then on the following day a recurrence of it, if it resulted from degenerative changes, either central or peripheral, occurring in the nervous system. These lesions do not undergo such sudden fluctuations, such mutability, as we observe in the paralysis. A persistent cause should produce a persistent and continuous effect.

4. Several, if not all, of the microscopists who discover degenerative changes in the peripheral nerves which supply paralyzed muscles state that some nerve-fibres have undergone complete or nearly complete degeneration, others partial degeneration, and others still seem to be intact. Would complete paralysis result from such a state of the peripheral nerves? Would, for instance, the velum palati, as we observe it, be motionless like a curtain, not exhibiting the least sensitiveness when pricked by the point of a pin or other instrument, if the sole cause of the paralysis were degenerative changes in the nerves? Would not the nerve-fibres which are still intact be sufficient to produce some motion? May we not, in at least some instances, regard the paralysis as the cause of the degeneration in the nerves?—for it is a well-known pathological fact that if a muscle be paralyzed—as, for instance, from a central cause—the nerves supplying it usually undergo more or less degenerative change.

5. A clinical fact antagonistic to the theory that lesions in the cerebro-spinal axis cause the paralysis has been alluded to both by Dr. A. Suss and Dr. W. H. Thomson in their interesting and instructive papers. It is that diphtheritic paralysis, motor and sensory, is sometimes limited to the muscles supplied by a single branch of a nerve, while the other branches have their normal function. This fact is, of course, not antagonistic to the theory that peripheral nerve-lesions cause the paralysis, but it affords a strong, if not conclusive, argument against the theory that central lesions are the cause.

Such are the clinical facts which militate against the theory that inflammatory or degenerative changes in the nervous system are the primary and sole cause of diphtheritic paralysis. We have stated above that the theory relating to the causation of diphtheria, which is now gaining acceptance in both continents with pathologists and specialists in diseases of children, is that the specific microbe of diphtheria acts locally upon the surface, and systemic infection occurs from ptomaïnes produced by microbic action, which, entering the lymphatics and blood-vessels, are carried to the interior of the body and exert their action upon the blood and the tissues. If this theory be true, the symptoms which indicate systemic infection are referable to the ptomaïnes. Dr. Thomson in his paper already alluded to writes as follows: "It is quite conceivable that a ptomaïne may follow upon the changes which the diphtheritic process sets up in the organism, and thus produce all its characteristic symptoms. The special tendency of diphtheritic inflammation to cause necrotic and gangrenous lesions lends further support to this surmise."

The ptomaïnes spring into existence suddenly and unexpectedly under favoring conditions, as we see in the case of the cheese or the milk ptomaïne, the tyrotoxicon; and it is not improbable that chemistry brought to the aid of microscopy will yet reveal the fact that the common cause of diphtheritic paralysis is a ptomaïne or chemical agent produced by microbic action. If the cause be a ptomaïne, it probably acts in a measure like the poison of the eel in the case alluded to by Trousseau, or like curare. Clinical facts appear to harmonize best with the theory that this is the common cause of the paralysis, especially in those cases in which it occurs early, and the use of the paralyzed muscles is soon regained. But it would be idle to argue that the marked degenerative central and peripheral lesions which are frequently present in the nervous system, in those who have died of diphtheritic paralysis, do not prolong and intensify the paralysis, and perhaps are sometimes the primary cause of it.

PROGNOSIS.—The prognosis of diphtheria, like that of scarlet fever, varies greatly in different cases according to its type. In some epidemics a large proportion of the cases are mild and recovery occurs with simple treatment. Between the mild and the most severe cases, attended by profound blood-poisoning, there is every grade of severity. Cases that are apparently mild in the beginning and seem likely to recover with simple measures sometimes become severe, dangerous, and even fatal. On the other hand, cases that set in with severity may become modified and end favorably with simple treatment. So variable is the type of diphtheria that in certain epidemics or localities a large proportion recover, as many even as 90 or 95 per cent., while in other epidemics or localities the proportion that perish is much larger.

The prognosis is usually favorable when the inflamed surface and pseudo-membrane are of little extent, the fever and swelling moderate, and the neighboring lymphatic glands and underlying connective tissue but little involved. In many such cases, as we have seen from the description given above, the patient remains in good general health or feels but slightly indisposed. On the other hand, if the inflamed surface be extensive, the pseudo-membrane deep-seated and exhaling an offensive odor, while the adjacent lymphatic glands are markedly swollen, the patient will probably perish. Nasal diphtheria, which is commonly present in severe cases, and which produces an offensive, irritating, and highly infectious discharge, always involves great danger. It is likely to give rise to systemic infection, since the submucous connective tissue of the nostrils contains numerous lymphatics, which take up the poisonous products and convey them to every part of the system. If, while the local disease is severe and extensive, the breath and exhalations become offensive and the countenance and surface generally begin to have a dusky, pallid hue, profound blood-poisoning has occurred and the patient will probably die.

Physicians of experience are guarded in the expression of a favorable prognosis in diphtheria, since there is no other disease in which the prognostic signs on which a favorable prediction is based are so likely to be fallacious. We hear much in medical circles of the deceptive character of diphtheria. Error in expressing a favorable prognosis, of which even physicians of ample experience complain, is largely due to the fact that diphtheria terminates fatally in several different ways. Death may occur from—

1. Diphtheritic blood-poisoning—systemic infection by the specific principle, whether acting directly or through the agency of ptomaïnes which it produces.

2. Septic blood-poisoning, produced by absorption from the under surface of the decomposing pseudo-membrane or from gangrenous tissues.

But our knowledge is not sufficiently advanced to enable us to discriminate between the constitutional effects of ordinary sepsis and those produced by the agency of the diphtheritic poison. Septic infection is obviously most likely to occur in those cases in which the pseudo-membrane is extensive, deeply imbedded, and its decomposition attended by an offensive effluvium. Cervical cellulitis and adenitis, which cause considerable swelling of the neck, often occur from septic absorption from the faucial surface, the septic matter being conveyed by the lymphatic vessels to the adjacent glands and causing inflammation of the glands and surrounding connective tissue. Considerable tumefaction of the neck therefore seldom occurs in diphtheria without manifest symptoms of toxæmia, and it is to be regarded as a sign of its presence.

3. Diphtheritic croup or pseudo-membranous laryngo-tracheitis, a most important disease, and fully treated of in the proper place.

4. Uræmia or diphtheritic nephritis, also one of the most important of the local maladies pertaining to diphtheria, and produced by the action of the diphtheritic poison.

5. Sudden heart-failure. The action of the heart may be feeble from granulo-fatty degeneration of the muscular fibres or from anæmia or general weakness; but sudden and unexpected death from heart-failure is commonly, as we have seen, due to paralysis of this organ.

6. Suddenly-developed passive congestion and œdema of the lungs, probably due to feebleness of the heart's action or to paralysis of the respiratory muscles. Death sometimes occurs, apparently from this cause, during the period of supposed convalescence and when the visits of the physician have been discontinued. Thus, in a case in my practice symptoms of œdema pulmonum (abundant moist râles in both sides of the chest and embarrassed respiration) suddenly occurred nearly one month after the disappearance of the faucial pseudo-membrane and inflammation. The urine, which had contained considerable albumen during the active period of the malady, had for some time shown no trace or but slight trace of this principle by the proper tests. By active stimulation these symptoms entirely disappeared in a few hours, and the heart's action seemed normal, except that it was a little weakened. On the following day the symptoms reappeared, and death occurred before I was able to reach the house.

That physician is obviously least likely to err in prognosis who recognizes the fact that patients are liable to perish in any of these different ways, and carefully examines in reference to all the conditions which involve danger. Many physicians, as I have had the opportunity to observe, are remiss in not examining more frequently the urine of diphtheritic patients; for there is often a large amount of albumen with granular casts in the urine in diphtheria, indicating a poisonous quantity of urea in the blood, and yet the appearance of the urine to the naked eye is normal.

Among the symptoms which render the prognosis unfavorable are repugnance to food, vomiting, pallor of countenance, and general anæmia, with progressive weakness and emaciation, indicating blood-poisoning; a large amount of albumen, with casts, in the urine, showing uræmia, to which the irritability of the stomach is often due; an abundant irrritating discharge of muco-pus from the nostrils or occlusion of them by membranous exudation or inflammatory thickening, showing that the Schneiderian membrane is seriously involved; hemorrhage from the nostrils, buccal cavity, or fauces, showing an altered state of the blood or of the walls of the capillaries, or plugging of the capillaries by masses of microbes or leucocytes. Diphtheritic laryngo-tracheitis, or pseudo-membranous croup, largely increases the aggregate of deaths from diphtheria, whether it be treated by improved inhalations, tion, or tracheotomy. Some of the above symptoms have been present t of the fatal cases which I have observed. On the other hand, the ct of recovery improves in proportion to their absence.

EVENTIVE TREATMENT.—Diphtheria is so highly contagious, and when ic is so likely to spread from one household to another, and its severe are fatal in so large a proportion of cases, that preventive measures are greatest importance. The area of contagiousness of diphtheria is small. ncery cites cases to show that it is limited to a few feet. Dumez also an instance showing that the contagious area is of small extent. In ol the boys and girls in the same hall were separated by an open space yards wide. Diphtheria prevailed among the girls, but did not affect ys. In this respect, as in so many others, diphtheria resembles scarlet and is unlike pertussis and measles.

e most efficient method of preventing diphtheria is the isolation and ction of patients, the prompt and thorough disinfection of the apart- in which patients have been treated and of the bedding and furniture se apartments, and the exclusion or prevention of all noxious gases, lly those ascending from the sewers and from filthy accumulations of ds.

. H. B. Baker of Michigan has published statistics showing that in 102 aks of diphtheria the average number of cases where disinfection and n, one or both, were neglected was 16, and the average deaths 3.26, in 116 outbreaks in which isolation and disinfection were enforced the e number of cases per outbreak was 2.86, and the average deaths .66. ore these precautionary measures prevented 13 cases and 2.57 deaths h outbreak; in the total, 1545 cases and 298 deaths. These statistics to only one year.[1]

is obvious that, in order to prevent the spread of diphtheria, wherever has occurred prompt and efficient personal and domiciliary disinfection be practised so far as the condition of the patient will allow. But s reason to think that disinfection as commonly practised is inadequate. winter of 1887–88 and the following spring an epidemic of diphtheria ed in the New York Infant Asylum, and it extended to the maternity In this ward 5 of the new-born infants contracted diphtheria, and 2 se 5 had at the same time umbilical phlegmons in addition to the usual eritic exudate upon the fauces. It was evident from the occurrence se cases that the maternity ward was infected to such a degree that uent patients could not be safely admitted without its thorough disin- . The ward was therefore vacated, the windows, doors, and crevices and forty pounds of sulphur, or two pounds to the hundred cubic feet were burnt until they were consumed. After some hours the windows ors were opened, and Drs. Prudden and Cheesemen immediately raised from the floor and bedding and allowed it to settle in culture-media. ier sources of infection were excluded from the media. The cultures ed so large a number of microbes that they overlay each other; but servers were able to distinguish the streptococcus pyogenes in the identical in form and appearance with the streptococcus which they had usly discovered in the umbilical phlegmon. Although more sulphur nployed than is recommended by the New York Health Board, and ed in the manner recommended by this board, it was inadequate to the microbes. It was evident that some more efficient mode of domi- disinfection was required.

ce the ordinary mode of disinfection was apparently futile in the ity ward, it seemed to me advisable to obtain the views of so eminent an authority as Dr. E. R. Squibb of Brooklyn; and he has kindly favored me with the following note:

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[1] *American Lancet.* (See *Ann. Univ. Med. Sci.*, 1888.)

"Within the past ten years the efficacy of sulphur-fumigation against infectious material has been repeatedly denied and reaffirmed upon very good authority, and observations, apparently made with accuracy and care, have been reported from time to time to prove both sides of the question; so that all that can now be said is that burning sulphur is of doubtful efficacy, with the weight of the highest authorities in bacteriology against it. But to this it must be added that it is still largely used by very intelligent bodies in large institutions, boards of health, etc., where it would not be likely long to maintain an unearned confidence.

"How often the fumes are applied dry and how often moist no one can tell from the current record; and how many of the failures of the dry gas would be successes in the presence of moisture there is no means of knowing.

"Formerly, when sulphur was burned in closed chambers as a disinfectant, the surfaces were all wetted, and the pot of burning sulphur was set in water or wet sand, that the heat might evaporate off a constant supply of watery vapor.

"These conditions are now frequently, if not generally, neglected; and where this is the case failure, on principle, should be the rule.

"Nearly all, if not all, chemical disinfectants are in a state of tension, ready to change on coming in contact with the matter to which they are applicable; and these changes are either by oxidation or deoxidation, and the moment of greatest power or activity is the moment of change, when they by reacting on infectious matter pass from a state of tension to a state of rest under new relations. The agency through which these changes almost universally become operative is the vapor of water.

"When sulphur is burned in a close chamber the dioxide is formed by condensing two molecules of oxygen from the air upon each molecule of the sulphur, and a heavy gas is the result, which tends to settle at the bottom of the chamber and to run out through the lower cracks. Any moisture present is at once seized by this rather inactive anhydride, first forming sulphurous acid, and then, by oxidation from the air, sulphuric acid. The dry gas, or anhydride, not only seizes with avidity all watery vapor in the air, but also the water held in the surfaces of all bodies with which it comes in contact, and in the presence of this moisture only is it ready for further oxidation. Then it is by this oxidation that it deoxidizes the matters with which it is in moist contact, filling the surfaces of these matters first with sulphurous acid, then, by the change, with sulphuric acid; and it is during these changes that its power is exerted.

"If there be no moisture supplied to the burning sulphur, that which was present in the air and the surfaces of the chamber is soon used up, and the dry gas remains indefinitely in a comparatively inactive, ineffective condition. The dry passive anhydride would necessarily destroy all organisms which breathed in any degree, because breathing-surfaces are moist. But in embryonic life protected by shell, as in seed, if the shell be dry the gas would be impotent. Many bacteriologists have admitted that burning sulphur would kill bacteria, but not germs."

It seems probable that the apparently negative effect of burning sulphur for the purpose of destroying the microbes in the maternity ward, as stated above, was due to the absence of moisture, for it was burnt dry. The above note from Dr. Squibb conveys very important information. If the facts as stated by him were more generally known and acted on by health boards and by physicians in family practice, the results of domiciliary disinfection ably be better. It is so important that the specific principle of should be destroyed wherever this disease appears, in order to pre- pagation, that any safe measures which will aid in producing this ld be employed with or without the sulphur fumigation. To this purpose, Dr. Llewellyn Eliot recommends during the con- a case the constant evaporation of turpentine over a water-bath, vapor fills the room. In every instance in which he has used the no second case of the disease has occurred.[1] I have stated, in my the prophylaxis of scarlet fever, that I have employed the follow- tion for the purpose of disinfection during my attendance on cases ever and diphtheria, with apparently so good a result that I am to continue its use:

℞. Acidi carbolici, ℥j;
Ol. eucalypti, ℥j;
Spts. terebinth., ℥viij. Misce.

blespoonfuls to one quart of water in a pan with broad surface, n a constant state of ebullition or simmering in the room occupied nt. This disinfecting vapor was employed in the quarantine wards nt Asylum, in which diphtheritic patients were treated, and to a nt in the other wards, and no subsequent cases have occurred.

vue Hospital, where pyæmia had been prevalent, Prof. R. Ogden nployed chlorine gas mingled with steam to secure disinfection, in g manner: Strips of paper having been pasted over the crevices doors and windows, equal parts of common salt and black oxide se (about two hundred pounds) were placed in troughs formed d, the edges being turned up to make receptacles. A carboy of cid was emptied into small basins and other vessels and placed troughs. The floors were moistened with water, and abundant llowed to escape from the heaters into the ward. With the aid s the sulphuric acid was quickly poured upon the mixture in the d the room hastily vacated, the door being nailed up to prevent entrance, for the large quantities of chlorine evolved would have The following day the windows were opened from without, and ation the contents of the troughs were stirred and sulphuric acid fore. In the ward most infected this process was repeated once, nd manganese being used. No further cases of pyæmia occurred ards. Even with the employment of a disinfectant vapor, the om or ward should not, in my opinion, be reopened until it has cted in the manner recommended by Prof. Prudden. It is to rub and walls with slices of fresh bread, and then apply to ceiling, loor a strong disinfectant solution, as of corrosive sublimate.

r to prevent as far as possible the spread of diphtheria, stringent hould be taken to prevent propagation of the disease by walking ildren mildly affected who are allowed to attend school and ride onveyances. I have in a number of instances seen children with sitting with other children in the clinics at Bellevue. Recently I sultation a child with fatal diphtheria, which apparently was con- the street by embracing a playmate who had been allowed to go first time after an attack of the disease. In another instance a with its parent to a Sunday mission-school in one of the tenement- ons of New York. Four or five days subsequently it had diph- h was communicated to other children of the family, and one of them died. The philanthropic endeavor to benefit the poor children of New York by conveying them to rural localities in midsummer has, it is said, resulted in the occurrence of diphtheria in farming sections where it was previously unknown. I have now under treatment a family with diphtheria, and the child first attacked states that a schoolmate sitting near her in the school complained of sore throat a few days previously. Certainly the safety of the public requires that all children with sore throats should be excluded from the schools whenever diphtheria is prevalent, and it should be the duty of teachers, acting under the direction of health boards, to see that this is done.

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[1] *Medical Bulletin.*

In a paper relating to the therapeutics of diphtheria, read before the Philadelphia County Medical Society, May 23, 1888, and printed in its *Transactions*, Dr. A. Jacobi remarks that the well children in a family where diphtheria is occurring should not go to church or school, and that schools should be closed during an epidemic of diphtheria, or, if not closed, that teachers should every morning inspect the throats of the pupils and send home those with sore throats. He recommends also the disinfection of coaches and railroad-cars at regular intervals during an epidemic. He also states that a patient recovering from diphtheria may contract it anew from the curtains, carpets, and furniture which he has infected during his sickness, so as to have a renewal of the disease. He has seen patients die from these renewals, and has seen other patients improve immediately when removed to other apartments. He also states that an irritated surface is more likely to contract diphtheria than one that is healthy, and therefore buccal, faucial, and nasal catarrhs should be promptly treated, the cure of these diminishing the liability to diphtheria. Chronic nasal catarrh, he says, should be treated with two or three daily injections of a solution of salt (1 to 130), to which a 1 per cent. solution of alum may be profitably added, and the same may be gargled in the treatment of faucial catarrh. A nasal spray of nitrate of silver (1 to 500 or 1 to 1000) also hastens the cure. The inflamed buccal surface should be treated by the potassium chlorate or sodium chlorate. Enlarged tonsils, which may harbor the diphtheritic virus, should be reduced by the galvano-cautery, and enlarged cervical glands should also be treated as a preventive measure. Very similar views were expressed in a paper read before the New York Academy of Medicine in January, 1888, by Dr. A. Caillé, who believes that he has prevented the recurrence of diphtheria in those who have suffered repeated attacks of it, by prolonged daily antiseptic treatment of their exposed surfaces, which harbored the poison or constituted a nidus favorable for its lodgment and propagation. Similar views were expressed in a paper read before the American Pediatric Society in June, 1890, by Dr. Caillé, who insists on the daily inspection of the throats of scholars whenever diphtheria is prevailing, and the exclusion from the schools of those who have sore throats.

TREATMENT.—Although diphtheria has been one of the most common of the severe infectious maladies in Europe and America during the last thirty years, physicians are far from agreeing in reference to the proper mode of treatment. The diversity of opinions in regard to the use of therapeutic agents is due in part to a variation in the type of the malady in different epidemics and localities, in part probably to the fact that other forms of inflammation of a severe type have been mistaken for the diphtheritic, but more to the fact that different theories have been held respecting the cause and nature of diphtheria. Hence one physician recommends with confidence, as eminently successful in his hands, a medicine or mode of treatment of which another speaks disparagingly.

The germ theory, as described in the foregoing pages, according to which is produced by a micro-organism, has had a marked influence upon of treatment. The question has been much discussed whether is primarily a constitutional or a local malady. Acceptance of heory does not require us to believe that diphtheria is primarily he specific microbe might enter and infect the blood through the re any symptom occurred, and, as we have stated elsewhere, the ative period of six or seven days in certain cases harmonizes with of a primary blood-disease, rather than with the theory that diph- the beginning strictly local, its seat being upon one of the exposed here the microbe has effected a lodgment. But the latter theory ave seen, more generally accepted, and certain facts lend strong it. But if diphtheria is primarily local, there can be no doubt the vaccine disease, the system becomes quickly infected in cases y severity, so that successful treatment requires the use of both nal and local remedies. Acceptance of the germ theory evidently e employment of germicide remedies, the so-called antiseptics or ts, externally and internally, in order to destroy the specific prin- e disease. Hence, in proportion as this doctrine was accepted, id, the chlorine preparations, bromine, the sulphites, salicylic acid, ost prompt and efficient agent of this class, corrosive sublimate, use.

ic Treatment.—The patient should be placed in an airy room, and tions should be promptly disinfected by chlorine, carbolic acid, or nfectant, and removed from the room. Purity of the air in the is required; but in the ventilation draughts of air through the ld be avoided, on account of the liability to diphtheritic croup, duces about one-third of the deaths from diphtheria. M. Jules ommends that the windows of the sick-room be constantly closed, entilation be obtained through the open window of the adjoining . In bathing the patient care must be taken that he be not chilled. hould be performed expeditiously in a warm room, with perhaps ase of the stimulants administered. The patient should be con- bed, and the temperature of the apartment should be from 70° to uniform temperature of the apartment at about 73° F. is safest. ysicians of experience recognize the importance of the use of the itious and easily-digested food and the preservation of the appe- iphtheria produces rapid destruction of the red corpuscles and loss d strength, and it may soon produce a state of dangerous weak- ef tea or the expressed juice of meat, milk with farinaceous food, d be administered every two or three hours or to the full extent vertaxing digestion. I have sometimes employed the pepsin prepa- fore each feeding, with apparently good results, as in the following

℞. Pepsini puri, in lamellis,	ʒj;
Acidi muriat. dilut.,	ʒij;
Glycerinæ,	℥j;
Aquæ puræ,	℥iv. Misce.

teaspoonful before each feeding.

es of feeble digestion the predigested foods are often very useful, ef peptonoids of Reed and Carnrick, the sarco-peptones of the ompany, and peptonized milk. Failure of the appetite and refusal d are justly regarded as very unfavorable signs. Trousseau says: *tion occupies the first* place in the general treatment; and I have observed that the severer the attack the more imperative is the necessity to sustain the patients with nourishing food. Loss of appetite—that is, disgust for every kind of food—is one of the most alarming prognostic signs. We must try to overcome the loathing of food by every possible means; and to get nourishment taken I sometimes do not hesitate, in the case of children, to threaten punishment. When the patient retains his appetite for food, there is good hope of recovery."[1] Occasionally, when great dysphagia is present, whether from the severity of the pharyngitis or from palatal paralysis, it is necessary to resort to rectal alimentation. The rectum absorbs, but does not digest, and it is capable of absorbing peptonized food to such an extent that life may be sustained for an indefinite time without stomach digestion and solely by rectal alimentation. For the purpose of rectal alimentation I have usually employed peptonized milk containing in solution peptonized beef, as the sarco-peptones of the Rudisch Company. If this is administered through a No. 12 to No. 14 elastic catheter introduced far enough to reach the sigmoid flexure, and retained for half an hour by a compress pressed closely against the anus by the fingers, the result is, I think, better than when we depend, as Trousseau did, entirely on stomach digestion. One objection to the use of the brush, instead of spraying the fauces with the atomizer, is that it is more likely to cause vomiting, by which nutriment, that is so much required, is lost. In malignant cases of diphtheria, as in scarlet fever of a similar type, patients are sometimes allowed to slumber too long without nutriment. It is the slumber of toxæmia, and should be interrupted at stated times in order to give food and stimulants.

Stimulants.—M. Sanné, in his treatise on diphtheria, says, "De tous les antiseptiques donnés à l'intérieur, l'alcool est de beaucoup le plus sûr. Plus l'infection est prononcée, plus il faut insister sur les composés alcooliques." He states that Bricheteau reports the history of a patient who took daily during diphtheria a bottle and a half of the wine of Bordeaux, without the least symptom of intoxication or headache. A similar case was related to me in which nearly one and a half pints of brandy were given in twenty-four hours without any ill effect, and with an apparent good result on the general course of the disease. The same rule holds true in diphtheria as in other acute infectious maladies, that while mild cases do well without alcoholic stimulants, they are required in cases of a severe type, and should be administered in large and frequent doses whenever pallor and loss of appetite or strength and flesh indicate danger from the diphtheritic or septic infection. It matters little how the stimulant is administered, whether milk punch or wine whey, provided that the proper quantity is employed. If given early and frequently in grave cases—as, for example, one teaspoonful every half hour of brandy or Bourbon whiskey—it does seem to have a tendency to render the disease more tractable; but to be instrumental in saving life in malignant cases it must be given boldly from the start. If there be marked diphtheritic toxæmia when its use is commenced, it will not save life, but it may prolong it. Although the liberal employment of alcohol is apparently useful, it cannot be regarded as a specific. In the quarantine wards of the New York Foundling Asylum in May, 1878, were four children between the ages of three and five years who had been sick a few days with severe diphtheria, and it was evident at a glance that they must soon perish with the ordinary mild sustaining remedies. Quinine, iron, the most nutritious food, and a moderate amount of alcoholic stimulants were being given, and we determined to increase the Bourbon whiskey to a teaspoonful every twenty or thirty minutes day and night. Nevertheless, whatever the result might have been with the earlier commencement of this treatment, the blood-poioning was now too profound, and one after the other died. That intoxication is almost never produced in this disease by large and frequent doses of the alcoholic stimulant is probably in part due to its quick elimination from the system, but more to the nature of diphtheria.

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[1] *American Lancet.*

In fulfilling the indication of sustaining treatment the vegetable tonics have long been used, especially cinchona and its alkaloid principle, quinine. The compound tincture of cinchona and the fluid extract have been used and recommended by physicians of experience, but of vegetable agents quinine has been and is still more frequently prescribed than any other. But the doses employed vary greatly in size and frequency in the practice of different physicians. It is administered for its antipyretic effect in large doses, so that twenty or thirty grains are given daily, and in small doses, as one or two grains every fourth hour, for its tonic effect. That there is nothing antagonistic in the action of quinine to the diphtheritic virus, and that it is beneficial in the same way as in the other acute infectious diseases, and no further, is, I think, generally admitted by physicians. Large and frequent doses do not, apparently, produce any controlling action on the course of the disease or diminish the blood-poisoning. Cases might be cited in illustration. In the case of a child of four years with malignant diphtheria forty-eight grains administered daily had no appreciable effect in staying the fatal progress of the disease.

Quinine in doses of three to five grains has been prescribed as an antipyretic in diphtheria, as also in the other infectious diseases; but as an antipyretic it is not very efficient, and the temperature after the first two or three days in diphtheria is not often so elevated that an antipyretic is required. As a tonic in doses of one to two grains it is probably to a certain extent beneficial, and it has been highly recommended by good observers for its local action upon the fauces when used by insufflation. The late Prof. Rochester of Buffalo recommended and practised in the treatment of diphtheria the insufflation of sulphate of quinine, in powders of two grains, upon the faucial surface, every two hours.[1] It is not improbable that benefit may result from its local action, for used in this manner it is antiseptic. But the employment of this agent by insufflation is very unpleasant to the child, and is likely to be resisted. Given in solution in doses of two grains, as in the following formula, it produces some local action on the fauces if drinks be withheld subsequently for a few minutes, and at the same time some tonic effect probably results from its use in this manner:

℞. Quiniæ sulphat., ʒss;
Syr. yerbæ santæ comp., ℥ij. Misce.

Give one teaspoonful every two to four hours to a child of five years. I have often prescribed quinine in this manner with apparent benefit in the treatment of diphtheria.

Tinctura Ferri Chloridi.—All physicians who are familiar with diphtheria have noticed the pallor and loss of appetite, flesh, and strength which commence before the close of the first week in severe cases, and which are always unfavorable symptoms, indicating as they do rapid and progressive deterioration of the blood. The use of iron is at once suggested as the proper medicinal agent to arrest this blood-change, from its known effect in increasing the number of red blood-corpuscles and the amount of coloring matter in these corpuscles. By its effect on the red corpuscles, which are the carriers of oxygen, it increases the functional activity of organs and improves the general nutrition. The ferruginous preparations, therefore, hold an important place in the therapeutics of diphtheria. The one which has stood the test of experience and is now commonly employed is the tincture of the chloride of iron. It should be given in large and frequent doses, as five drops hourly to a child of three years.

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[1] *New York Medical Journal.*

Ferguson[1] regards the tincture of the chloride of iron as the most valuable of all remedies for diphtheria. He examined the blood daily or every second day in twenty cases of diphtheria, and was astonished to observe how rapidly the red blood-corpuscles were reduced in number, those remaining presenting an unhealthy appearance. He believes that the iron partially arrests the blood-change. He administers as much as can be tolerated. To a child of ten years he gives hourly one teaspoonful of the following mixture in water:

℞. Tinct. ferri chloridi, ℥j;
Syr. simplic., ℥iij. Misce.

If the stomach do not tolerate this dose, half a teaspoonful is administered every half-hour. An infant of seven months, greatly prostrated, took every hour one teaspoonful of the following:

℞. Tinct. ferri chloridi, ʒij;
Syr. simplic., ℥iv. Misce.

A lady of twenty-two years, having an excessive formation of pseudomembrane and a very fetid breath, took daily one and a half fluidounces of the iron for ten days.

M. Jules Simon says:[2] "For internal treatment from three to six drops of the tincture of the chloride of iron should be given in a little water every two or three hours; but it should not be given with milk or gum-water or from a metallic spoon, on account of the decomposition which occurs, which may produce digestive troubles." Dr. Whittier believes that this medicine, given so as to saturate the system, is the best that can be employed. In thirty-six consecutive cases in which the fauces were covered with the exudate, all recovered under the use of the iron as the principal medicine.[3] Dr. S. Baruch of New York prescribes hourly doses of this remedy in quantities varying from eight to twenty-five drops mixed with glycerin and water. Food and stimulants are administered before the iron, but not immediately afterward, so that the iron may have a local action upon the faucial surface.[4] Dr. Billington recommends hourly teaspoonful doses of the following mixture:

℞. Tinct. ferri chloridi, f℥j;
Glycerinæ,
Aquæ, *āā.* ℥j. Misce.

Prof. Joseph E. Winters says that he has given two drachms of the tincture of the chloride of iron every half hour for forty-eight hours, with manifest benefit, to a child of eight years.[5] But it is only in the most severe or malignant form of the disease, the form described by Sanné as septic phlegmonous, that such large doses are proper or are required. In mild cases from three to five drops given hourly or oftener suffice. This is the dose recommended by Jules Simon of Paris.

Several recent writers make the plausible statement that the indication of treatment by the iron is to saturate the system as soon as possible, employing for this purpose as large and frequent doses as can be tolerated by the stomach. The tolerance of a drug depends largely on the manner in which it is employed. The best vehicle for the tincture of the chloride of iron is glycerin and water. It may be conveniently prescribed with two or three times its quantity of glycerin and a certain number of drops administered in water. The advice of Simon should be borne in mind, not to give it with gum-water nor with milk nor from a metallic spoon.

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[1] *Canadian Practitioner.*
[2] *Le Progrès médical.*
[3] *Boston Medical and Surgical Journal.*
[4] *New York Medical Record.*
[5] *Diphtheria and its Management*, 1885. (See *Ann. Univ. Med. Sci.*, 1888.)

That now, after nearly half a century of the constant use of iron in diphtheria in both hemispheres, there is an almost unanimous verdict in its favor, renders it probable that the few who have not observed its good effects have treated unusually bad cases or have given the medicine in small and inadequate doses. We shall see that the opinions of physicians have not remained equally favorable in regard to the use of the agent with which the iron has been commonly combined, the potassium chlorate.

Potassium Chlorate.—This agent produces a curative effect on buccal inflammations, and its beneficial action when employed for the various forms of stomatitis has led to its extensive use in pharyngitis. When taken internally it is eliminated in part by the salivary glands, so that it continues to exert in part a local action on the surface of the mouth and fauces until it is entirely eliminated. This medicine, the potassium chlorate, has of late years become also a domestic remedy, but the laity should be cautioned in reference to its use. It is an irritant to the kidneys in large doses, producing intense inflammatory congestion of these organs and arresting their function. The melancholy fate of Dr. Fountaine of Davenport, Iowa, in 1861, whose life was sacrificed by an experimental dose of potassium chlorate, is remembered by the older physicians. Fountaine took half an ounce in a gobletful of warm water at eight A. M. Free diuresis occurred, which ceased at four P. M. Though fatigued and pallid, he ate a hearty supper. During the following night he was in collapse, with vomiting and purging and severe abdominal pain. Early in the following morning he voided two ounces of dark urine, after which no urinary secretions occurred. The choleraic symptoms returned, with collapse, but he again rallied. He had vomiting and intense and constant abdominal pain during the subsequent six days, when death occurred. The total cessation of fecal and urinary evacuations for six days was a notable fact. At the autopsy the lesions of an intense and general gastro-intestinal inflammation were present, the mucous membrane hanging in shreds and patches; the bladder was empty, and its mucous membrane presented a similar appearance to that of the stomach and intestines. The condition of the kidneys is not stated, except that there was liquid resembling urine under the capsule of one kidney and crystals of the chlorate were in the pelves of the kidneys. A few years since, in my practice, a child of three years with active diphtheritic pharyngitis was allowed to quench its thirst by drinking water from a small pitcher in which three drachms of potassium chlorate had been dissolved, and which had been ordered as a gargle. In the morning I was summoned in haste, and found the surface of the patient cold and blue and pulse feeble. The urine was totally suppressed, and instead of it a few drops of blood passed from the urethra. Death occurred before night.

Jules Simon[1] says that potassium chlorate, acting wonderfully well in diseases of the mouth, produces no beneficial effect in diseases of the fauces, and it weakens the little patient when given in large doses. Dr. J. P. Esch says that he has observed that the potassium chlorate used internally in diphtheria almost invariably produces symptoms of nephritis. Ferguson[2] totally condemns its use in any dose or mode of administration in diphtheria. In every case in which he employed it, if albuminuria were present it increased the amount of albumen. Von Focke[1] believes that any benefit which may be derived from the potassium chlorate in diphtheria results from the oxygen in it. To render the oxygen more efficient, he adds hydrochloric acid. He prepares a 2 per cent. solution of the chlorate, with a 1½ per cent. solution of the acid, and administers a half-teaspoonful to two teaspoonfuls, according to the age, every one to two hours. All the benefit obtained from this mixture may be derived from a prescription long used and favorably known in New York, and probably more frequently written than any prescription for diphtheria. The tincture of iron in the mixture contains one minim of free muriatic acid in each drachm, but a small amount of this acid is added to the mixture in addition. The prescription, with some variations in its proportions in the practice of different physicians, is as follows:

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[1] *Le Progrès médical.*

[2] *Canadian Practitioner.*

℞. Tinct. ferri chloridi, ʒij–iij;
Potas. chlorat., ʒj;
Acidi muriat. dilut., gtt. x;
Syr. simplic., ℥iv. Misce.

Dose: One teaspoonful hourly or each second hour.

After such an extensive use of potassium chlorate during nearly half a century its therapeutic uses should be clearly defined, and any ill effects which may result fully determined. From what is now known of its action, it would probably be better to abandon its use in diphtheria, since it is a remedy of doubtful efficacy for throat affections. If it be employed, it should certainly be administered in small doses sufficiently diluted. If it be prescribed, it should not, I think, be in larger quantity than half a drachm in twenty-four hours for a child of five years.

The remedies mentioned above are those which have been most largely employed for internal medication by physicians of the present and the preceding generations; but the belief that diphtheria has a microbic origin, that the action of the microbes gives rise to poisonous ptomaines, and that the virulence of the disease is due to these organisms and chemical products, has during the last few years brought into prominence the germicide and antiseptic treatment. The attempt is now made—and apparently with considerable success—to cure the patient by antagonizing and destroying the cause of diphtheria. We look with interest and for enlightenment to the results of treatment by the antiseptics, and compare them with the results obtained by the use of tonics, stimulants, and alimentation, which have been heretofore employed.

Among the most useful of the statistics bearing upon the action of germicide and antiseptic remedies in the treatment of diphtheria are the following, made by N. Lunin in the hospital of Oldenburg in 1882.[2] In this hospital 296 children had diphtheria, and 164, or 55 per cent., died. The treatment by corrosive sublimate consisted in brushing the pharynx every two hours with a solution of 1 part to 1000, or in spraying by the irrigator of Rauchfuss with a solution of 1 part to 5000. The patients subjected to this treatment numbered 57: 43 of them had the fibrinous form of the disease, and 14 the septic phlegmonous form; 13 of each class died, or 45 per cent. of the whole number. The tincture of chloride of iron Lunin employed in small doses, only one drop every quarter-hour, or two drops every half-hour, in 94 cases, 43 having the fibrinous form and 51 the septic phlegmonous form. The total mortality was 56.3 per cent. Irrigation of the fauces was also employed in these cases with a 3 per cent. solution of boric acid. Lunin made use of chinoline in 28 cases—19 of the fibrinous form and 9 of the septic phlegmonous form: 15 died, or 53 per cent. This agent was prescribed in a 5 per cent. solution, the medium being half water and half alcohol. Twenty-nine children were treated by resorcin, a solution of 10 per cent. being applied by the brush twice hourly, and irrigation with a 1 per cent. solution once hourly. 65 per cent. died. A solution of bromine and bromide of potassium was applied from one to three times hourly to the fauces in 33 patients, but 69.7 per cent. died.

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[1] *Wien. med. Wochenschr.*

[2] *Archiv für Kinderheilk.*, 1886.

Finally, 23 infants were treated by turpentine, a tablespoonful twice daily, and in some of the cases an additional hourly dose during two or three days. The mortality was 43.4 per cent. In the fibrinous form the percentage of deaths from the different modes of treatment was as follows:

	Percentage.		Percentage.
By turpentine	8.30	By chinoline	31.60
" resorcin	20.00	" tinct. ferri chloridi	32.60
" corrosive sublimate	30.20	" bromine	46.70

In the septic form the deaths were as follows:

	Percentage.		Percentage.
By tinct. ferri chloridi	76.5	By resorcin	89.5
" turpentine	81 0	" corrosive sublimate	92.9
" bromine	88.9	" chinoline	100.0

Therefore, according to Lunin's statistics, turpentine was the most useful agent in the fibrinous form of diphtheria, and the tincture of the chloride of iron in the septic phlegmonous form.

Hydrargyri Chloridum Corrosivum (*Hydrargyri perchloridum*, Br. Phar.).—The use of this agent in the treatment of diphtheria is based on the theory of the microbic origin of this disease. Corrosive sublimate is the most active and certain of the germicide agents employed in medicine, whether used locally or internally. It quickly destroys all micro-organisms with which it comes in contact, and in safe medicinal doses it is believed to penetrate all parts of the system. The employment of corrosive sublimate in the treatment of diphtheria is not new, since it appears that the late Dr. Tappan of Steubenville, Ohio, prescribed it with apparent benefit in 1860–61; but it was seldom prescribed as a remedy in this disease until within the last four or five years. The establishment of the theory of the microbic origin of diphtheria, and a knowledge of the fact that the sublimate is the most efficient germicide, have made it the favorite remedy with many physicians. Of course its employment demands caution, and is justified only by the fact that the disease for which it is prescribed has hitherto been very fatal with other modes of treatment. Though this agent is now widely used for diphtheria, medical journals thus far contain very few reports of its supposed toxic or injurious action, while many physicians believe that it diminishes the virulence of diphtheria and increases the percentage of recoveries.

In ordinary cases the following may perhaps be regarded as about the proper quantities which should be administered in divided doses in twenty-four hours: For a child of two years, gr. $\frac{1}{6}$ (gr. $\frac{1}{72}$ every two hours); for a child of four years, gr. $\frac{1}{4}$ (gr. $\frac{1}{48}$ every two hours); for a child of six years, gr. $\frac{1}{3}$ (gr. $\frac{1}{36}$ every two hours); and for a child of ten years, gr. $\frac{1}{2}$ (gr. $\frac{1}{24}$ every two hours). Thus, if we employ the vehicle which Dr. Tappan used a quarter of a century ago, the following prescription might be written for a child of six years:

R. Hydrarg. chlor. corros., gr. j;
Alcoholi, ℥ij;
Elix. bismuthi et pepsinii, q. s. ad ℥iv. Misce.

Dose: One teaspoonful every two hours.

According to the statement of physicians, considerably larger doses have been administered with safety and apparent benefit, and in severe cases attended by profound blood-poisoning, such as Lunin designates septic phlegmonous, certainly the maximum medicinal dose is required if we depend on the sublimate as the main remedy. Dr. Grant (Bey) administered to a child of four years one-half grain every half-hour till six doses were taken, and then hourly during the first day, every second hour on the second day, and on subsequent days at longer intervals. Dr. A. Jacobi states that an infant a year old may take one-half grain every day for many days in succession with very little, if any, intestinal disorder and with no stomatitis. Although certain children may tolerate doses so large as those recommended by Dr. Grant (Bey), safer doses are those which we have recommended above, and they seem to be sufficient for protracted use. Dr. P. Werner[1] recommends in the treatment of diphtheria the sublimate dissolved in distilled water, in half-hourly doses or at a little longer interval, so that the following quantities are taken in twenty-four hours: For an infant of one and a half years, 0.015 (grain 0.231) of the sublimate in 120.0 (4 fl.oz.) of water; for a child at the age of six to seven years, 0.3 in 180 (grain 0.45 to 6 oz.) of water. The quantity is to be given in divided doses in the twenty-four hours. At night, if the child sleep, the doses should be less frequent and proportionately larger than in the day-time. Dr. I. N. Love of St. Louis states that he has employed the sublimate in doses of one-one-hundredth to one-fiftieth grain every hour or second hour, according to the age, preceded by large draughts of water. Its action as thus used seemed to be both local and constitutional.

Those who denounce the use of mercurials in diphtheria, like Jules Simon and one at least of our distinguished American writers—grouping together calomel, the oleate, the unguentum, the cyanide, the biniodide, and corrosive sublimate, condemning them in a body—on the ground that they enfeeble the system, do injustice to the therapeutic virtues of the sublimate. Medicines having the same base often differ widely in their action upon the system; and it is the common and probably correct belief that the sublimate in safe medicinal doses does not enfeeble the system, but in some instances acts rather as a tonic.

In my practice excellent results have apparently occurred from the local use of corrosive sublimate—its use by the atomizer. If the sublimate be administered internally at the same time, care must be taken not to employ too much. The solution which I have prescribed with the atomizer consists of two grains of the sublimate to one pint of water, and in spraying the fauces the bulb of the atomizer is compressed from three to five times. In ordinary cases the spray is used every second hour. Oatman of Nyack, New York, has lost but 1 patient in 23 by the following local treatment: Cotton is firmly wound around the end of a stick about the size of a lead-pencil, being drawn out as it is wound, and made to project beyond the end. This is dipped into a solution of the bichloride of mercury, two grains to the pint (1 to 3840), and passed into the throat until it touches the posterior wall of the pharynx. It is then instantly withdrawn and burnt. This treatment is repeated hourly with a new swab each time, until the inflammation begins to subside, which is usually in forty-eight hours. Jules Stümf[2] treated 31 cases, with 2 deaths, by inhalation of the sublimate, using the apparatus of Richardson. For infants under the age of two years he employs 1 part to 4000; from five to six years, 1 part to 2000; for those over six years, 1 part to 1000. Dr. Thomas Welcher recommends in the treatment of diphtheria,[1] used as a gargle or employed as a spray, a solution of corrosive sublimate of 1 to 1000. In most instances, when this local treatment had been employed a few times at intervals of one to two hours, the pharyngeal disease began to abate and the general condition improved. Dr. Welcher also employs small doses of the sublimate internally. It is evident from the experience of other physicians that when this agent is used as a spray in so strong a solution as 1 to 1000, it should be used with caution. Two or three compressions of the bulb will be sufficient. Prof. A. Jacobi recommends for washing the nares a solution of corrosive sublimate of from 1 part to 2000 to 1 part to 10,000, with or without 10 to 50 parts of table-salt or 60 to 300 parts of boracic acid.

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[1] *St. Petersburg. med.* Wochenschr., 1886.

[2] Münch. med. Wochenschr.

The medical journals during the last three or four years contain abundant testimony to the beneficial results of both the internal and the local use of corrosive sublimate in diphtheria. An important question evidently arises—to wit, how to use this active agent internally and locally at the same time without administering too large a quantity. Some physicians administer the amount that can safely be employed in twenty-four hours dissolved in water and in frequent doses (every hour or second hour), and if no drinks be given subsequently for a few minutes the local effect upon the fauces is to a considerable extent obtained. Perhaps this is the safest and best mode of employing this very efficient and useful antiseptic agent in the treatment of diphtheria.

Calomel.—Dr. Simon Baruch begins the treatment of all cases of diphtheria not attended by diarrhœa by a dose of four to eight grains of calomel, followed, if necessary, by a laxative.[2] He cites the experience of Dr. Coester, who administered, in the preliminary treatment of diphtheria, calomel in 69 cases, and lost only 1. Prof. Simon of Paris in the treatment of diphtheria discards (1) blisters, which are always followed by the reproduction of pseudo-membrane; (2) bleeding and mercurials, which enfeeble the patient; (3) preparations of opium, which produce rapid depression of the vital powers; and (4) potassium chlorate in large doses. The reference of Simon to mercurials is probably more particularly to calomel.[3]

On the other hand, Dr. Geo. B. Fowler considers calomel the best remedy with which to combat diphtheria. When croupy symptoms supervene he increases the dose from gr. ⅛ to gr. ⅓, or even 1 grain, every hour.[4] Dr. I. N. Love remarks that the most marked recent recommendation of the use of calomel in diphtheria is from the pen of Dr. William H. Daly, chairman of the Laryngological Section of the Ninth International Medical Congress.[5] Dr. Daly's method is to administer the calomel two to five grains every one, two, or three hours until free catharsis follows, and then at longer intervals, but so that three or four daily evacuations are produced. The editor of the *Therapeutic Gazette* writes: "We have so frequently seen an apparently severe attack of diphtheria abruptly aborted in its inception under the influence of large doses of calomel that we can scarcely believe that the drug has no pronounced effect. A grain of it should be put dry in the mouth of the child every hour or two until frequent, very loose, liquid evacuations are produced."

In addition to those already mentioned, other physicians of ample experience have recommended calomel in the treatment of diphtheria, some in laxative doses and only at the beginning of the attack, and others in doses of the fractional part of a grain every two to four hours during the sickness. The majority of physicians—very properly, in my opinion—discourage the employment of calomel in laxative doses, believing that it tends to weaken the patient and increase the anæmia, which in all cases of severe diphtheria soon becomes very manifest, whatever the treatment; but a single laxative dose is perhaps sometimes useful. It may do good, as in other infectious diseases, to unload the *primæ viæ* in the commencement of the attack, so that the remedies to be employed are more readily absorbed and without alteration by admixture with chemical products in the intestinal tract. What change calomel undergoes so that it can be absorbed has not been clearly ascertained.

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[1] *Deutsche med. Zeit.*

[2] *New York Medical Record.*

[3] *Jour. de Méd. de Paris.*

[4] *New York Medical Record.*

[5] *Weekly Medical Review.*

Turpentine.—This has been highly recommended recently by physicians of experience, when used locally as well as internally, for its prompt action in arresting the formation and extension of the pseudo-membrane and as an antidote to the diphtheritic virus. Dr. Rewentauer states that an infant of two years treated by other remedies began to have symptoms indicating invasion of the larynx on the fourth day. Tracheotomy was resolved upon, but previous trial was made of pure turpentine in a teaspoonful dose. The croupiness ceased, other symptoms improved, and the patient recovered without tracheotomy.[1]

Delthil and, following him, Schenker employed a mixture of coal-tar and turpentine, which was burnt in the room occupied by the patient either constantly or several times through the day. Schenker's observations led him to believe that the benefit from this treatment occurred chiefly from the turpentine, and largely from its general effect on the system. He therefore decided to employ turpentine internally in doses of ten minims to one teaspoonful, one to three times daily, in milk, sugar-water, or gruel. At the same time he employed it as a spray. Alcoholic stimulation, cleanliness, and a diet of beef tea, milk, and egg were enjoined. Of 36 cases which Dr. Schenker treated by turpentine, 31 recovered.

Röse of Hamburg employed turpentine in teaspoonful doses mixed with spirit of ether (ether one part, alcohol three parts) three times daily. A teaspoonful of a 2 per cent. solution of salicylate of sodium was also given every two hours. Under this treatment the temperature and pulse diminished, other symptoms improved, and in 58 cases thus treated 95 per cent. recovered.[2] Sigel also prescribed turpentine in teaspoonful doses in 47 cases, in 14 of which the question of tracheotomy arose. A manifest reduction of temperature followed the use of the turpentine. The percentage of deaths in all thus treated was 14.9, while of those treated by corrosive sublimate, salicylic acid, potassium chlorate, etc., 32.5 per cent. died. Dr. Llewellyn Eliot also reports good results from the vaporization of turpentine.

The recent recommendation of turpentine in the treatment of diphtheria by many physicians of large experience and sound judgment, among whom we may mention Drs. S. Baruch and A. Jacobi, has extended and established the use of this agent. Its supposed efficacy depends on the fact that it is antiseptic and germicidal, and that when vaporized and inhaled or taken by the stomach it penetrates all parts of the system. The descriptions long given in the text-books of the physiological action of turpentine have had the tendency to induce physicians to employ it in small doses. But I am not aware that any writer has recorded ill effects from the use of turpentine in diphtheria, although it has been employed by a considerable number of physicians in the last year or two, and in quantities which exceed the medicinal doses mentioned in text-books.

It is well known that the constitutional effects of the oleum terebinven to impaired vision, strangury, and bloody urine, may be obtained prolonged inhalation of its vapor;[1] and I have employed the vapor il of turpentine during the last two or three years with such appa- d results that I confidently recommend the mode of using turpentine nmended in our remarks under the head of Prophylaxis. Turpentine bably in the future be a very important remedy in the treatment of ria, whether taken by the stomach or received as a spray.

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[1] *Centralbl. f. klin. Med.*

[2] Therap. Monatsh.

carpine.—Certain physicians have recommended pilocarpine in the nt of diphtheria, because it is supposed that the salivary and mucous ns which it produces aid in throwing off the pseudo-membrane. Dr. ites that the 10 patients treated by him, some of them severely sick, all ed.[2] He employed the following prescription:

℞. Pilocarpini hydrochlorat.,	gr. ½ to ⅓;
Acidi hydrochlorici,	gtt. ij–iij;
Pepsini,	gr. x–xij;
Aquæ destillat.,	℥xviiss. Misce.

teaspoonful or tablespoonful in wine.

tmann treated in a year and a half 81 cases by this remedy without . Gelsner and Delewsky also report good results. On the other have seen the most disastrous effects from the use of pilocarpine in ria, the secretions filling the bronchial tubes and being expectorated ently and with great difficulty. Death resulted. The symptoms occurred were like those in extreme œdema of the lungs. I cannot e recommend its use. Its employment appears too hazardous, espe- n young and feeble children.

ium Benzoate.—Dr. I. N. Love recommends the sodium benzoate , ten-, or fifteen-grain doses.[3] He remarks that Salkowski in 1879 that this drug largely increased the secretions by the kidneys of nitrog- and sulphurous compounds, and concluded that it would aid in ing the blood of noxious matters. Salkowski, Fleck, and Buckholtz ned that the benzoate arrested the growth of micro-organisms in liquid, and Graham Brown that diphtheritic liquids became non- ous by the addition of the benzoate. Helferich, Graham Brown, and from experiments made on animals, consider the benzoate of sodium fic against the virus of diphtheria.[4] On the other hand, M. Dumas, to the Hôpital de Cette, has not derived any marked benefit from its l Dr. A. Jacobi says that it does not deserve the eulogies bestowed from theoretical reasonings.[5]

h are the more important remedies, used internally, which have been e present time employed in the treatment of diphtheria. The num- s seen, is large, and most of them are no doubt useful in certain cases. eria, being a disease of variable type, must be treated according to the ons in each case. The internal remedies which in my opinion have ost useful, and which should be most frequently employed, are the of the chloride of iron, quinine, corrosive sublimate, turpentine, and holic preparations.

ong the other remedies which have been recommended by good rs, we may mention the following: Copaiba and cubebs are employed ommended by distinguished French physicians. Jules Simon pre- copaiba and cubebs for patients over the age of five or six years.[6]

llé and Maish.
[2] *Medical News.*
eekly Medical Review.
[4] *La France médicale.*
w York Medical Record.
[6] *Le Progrès médical.*

Dr. I. H. Fruitnight has employed the sodium hyposulphite in 8 cases, giving hourly drachm doses of the following: ℞. Sodii hyposulph., ʒj; Aquæ f℥ij. The result was favorable. Illingworth[1] recommends the biniodide of mercury. Dr. C. B. Galentine recommends the internal use of hydrate of chloral, given with the potassium chlorate to a child of six years in about 2½-grain doses. Herbert L. Snow recommends sulphurous acid, Dr. Hofmann the hydrogen dioxide, and E. S. Smith the oil of eucalyptus and Warburg's tincture. In diphtheria, therefore, as in other diseases which in a large proportion of cases end favorably whatever the treatment, the number of recommended remedies is large.

Local Treatment—Solvents.—The belief is becoming prevalent in the profession that the early destruction and removal of the exudate from the faucial or nasal surface is not an imperative duty, as was formerly practised under the teachings of Bretonneau and Trousseau, provided that thorough disinfection of the pseudo-membrane and the surrounding and underlying tissues be effected. Patients are injured by irritating lotions or instrumental treatment designed to remove the pseudo-membrane, which immediately reappears in greater extent and thickness than at first, on account of the increase in the inflammation in consequence of the severe measures employed. The employment at short intervals of mild but efficient antiseptic applications in place of the stronger and irritating lotions formerly used has been a great improvement in the treatment of diphtheria. But antiseptic lotions, vapors, or sprays are inadequate to produce complete disinfection if the pseudo-membrane has great thickness. Its under surface, which is in immediate relation with the lymphatics and blood-vessels, and from which systemic poisoning occurs from absorption of the diphtheritic germ, septic matter, or ptomaines, is probably not reached by the antiseptic sprays or lotions as commonly employed. Any painless and unirritating application which diminishes the thickness of the pseudo-membrane by its solvent action, or, better, entirely dissolves and removes it, is therefore useful. Of the unirritating solvents alkalies, pepsin, trypsin, and papayotin have been chiefly used, and have in the highest degree the confidence of the profession. The efficiency of solvent treatment depends largely on the manner in which it is employed, the kind of instrument used, and the frequency of the application. The solvent agent heretofore most largely used has been lime-water or the spray of slaking lime. Its solvent action is probably due chiefly to its alkalinity, but its alkalinity and its solvent action can be greatly increased by adding to it the sodium bicarbonate. From observing its effects in a considerable number of cases the writer recommends with confidence the following formula:

℞. Ol. eucalypti, ʒij;
Sodii benzoat., ʒj;
Sodii bicarbonat., ℥ij;
Glycerinæ, ʒij;
Aquæ calcis, Oj. Misce.

To be used with the hand-atomizer from three to five minutes every half-hour, or with the steam atomizer almost constantly. This alkaline spray not only exerts a solvent action on thè pseudo-membrane, but also renders the muco-pus thinner, less viscid, and therefore so changes its character by diminishing its viscidity that it is more easily expectorated.

The use of *pepsin* as a solvent is suggested from its well-known action in digesting nitrogenous substances. It has been employed with varying results. It is well known that some of the preparations in the shops are much more than others, and hence perhaps a chief reason for the difference in the obtained. It is well to remind the reader that it should be employed or with an acid, for it is comparatively inert if used with an alkali.

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[1] British Medical Journal.

ossbach states[1] that he has used a solution of *papayotin*, or vegetable n, frequently applied to the fauces. In young children a few minims be placed on the tongue every five minutes. If the drug be good, he that the membrane is dissolved in two or three hours. Dr. Jacobi that this agent is readily dissolved in twenty parts of water.[2] It may, ys, be brushed over the surface or used as a spray. Mixed with water glycerin in greater concentration (1 to 4–8), it has been used by him fair results. Dr. J. K. Bauduy, Jr., also writes favorably of the solv-ction of papayotin on the pseudo-membrane.[3]

Trypsin, unlike pepsin, is an active solvent in an alkaline medium, and it be added to the alkaline mixture described above. Dr. F. C. Fernald es the case of a boy of six and a half years who had perforation of membrana tympani and began to complain of sore throat. A pseudo-brane appeared upon the tonsillar portion of the fauces, and the right itory canal was covered with a diphtheritic exudate, entirely occluding o that liquids did not flow from the external ear to the fauces as formerly. ear was filled every half-hour with the following mixture: ℞. Trypsin., xx; Sodii bicarb., gr. x.; Aquæ destillat., ℥j. The pseudo-membrane grad-y dissolved and disappeared, the passage through the ear and Eustachian became open, and the patient recovered.[4] Dr. E. N. Liell also relates se in which trypsin apparently produced a solvent action on the pseudo-brane. Probably, therefore, in the present state of our knowledge we apply no better solvent mixture upon the diphtheritic pseudo-membrane trypsin added to the alkaline solution described above.

Albuminuria.—This being due to septic nephritis, patients have seemed ne to be more benefited by the tincture of the chloride of iron, in fre-nt and rather large doses, than by any other remedy. If while this is g used a marked diminution in the quantity of urine occurs, it may be ssary to employ diuretics and laxatives, as in scarlatinous nephritis. potassium bitartrate or acetate, and perhaps the more laxative salines, be needed under such circumstances. But marked diminution of urine d especially anuria—in diphtheria ends fatally, with few exceptions, rding to my observations, whatever the treatment.

Paralysis.—The loss of the tendon reflexes, and palatal and multiple lysis, require the same stimulating and sustaining remedies which are opriate for the primary disease, diphtheria. Iron and other tonics, nutri-s and easily-digested diet, massage, and in some instances electricity, ce to restore the use of the affected muscles, but sometimes weeks and months elapse before their use is fully restored. So long as the paraly-oes not affect any vital organ, a favorable prognosis may be expressed, ugh recovery may be slow.

n the other hand, it is evident from its nature and from the cases h have been related that cardiac paralysis is exceedingly dangerous, must be treated promptly and by the most active remedies. As we seen, the attack of cardiac paralysis is usually sudden, with little fore-ing, and is often fatal before the physician, promptly summoned, is to arrive. The patient should be as quiet as possible in bed, with the low, and alcoholic stimulants should be administered at once. In the en seizures, such as have been related above, hypodermic injections of dy act most promptly in sustaining the heart-action. Ammonia, camphor, musk, and the electrical current may be useful auxiliaries. The predigested beef preparations, peptonized milk, and other concentrated foods designed for those with feeble digestion are useful. If the urgent symptoms are relieved by these measures, such remedies should be employed as are useful in other forms of diphtheritic paralysis. The patient is ordinarily feeble, anæmic, and with poor digestion. The beef extracts and concentrated foods should be continued. Iron, quinine in moderate doses, and alcoholic stimulants are indicated. The use of the electric current is suggested by the nature of the attack. Many physicians believe that they have obtained benefit from its use in the treatment of the more common forms of diphtheritic paralysis, while others speak doubtfully of its efficacy. If there is reason from the symptoms to suspect the presence of central lesions in the nervous system, the galvanic current in short sittings has been recommended, and not the faradic. In ordinary cases either the direct or the induced current may be employed.

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[1] *St. Petersburg. med. Wochenschr.*, 1886.

[2] *New York Medical Record.*

[3] *Medical Weekly Review.*

[4] *Medical News.*

Strychnine is, however, regarded by good observers as the most efficacious nerve-stimulant in the various forms of diphtheritic paralysis. Oertel's objection, expressed twenty years ago, to the use of strychnine in this disease, that, acting as an excitant of the spinal cord, it is likely to aggravate central lesions, was founded on a wrong understanding of the pathology of the paralysis. Prof. Henoch cured diphtheritic paralysis in three weeks by hypodermic injections of strychnine. W. Reinard[1] states that a boy three and a half years of age fifteen days after the appearance of the diphtheritic patches on the tonsils had paralysis of the inferior extremities and the velum palati, a tottering gait, nasal voice, and difficult deglutition. At the end of twelve days death seemed imminent, the paresis of the lower extremities had become a complete paraplegia, and the paralysis of the upper extremities and of the muscles of the nucha, larynx, and thorax was complete. He was unable to sustain himself in the sitting posture, his head falling heavily on his chest. He had also dyspnœa, hoarse cough, tracheal râles, and aphonia, probably from cardio-pulmonary paralysis. Reinard made a hypodermic injection each day of one milligramme (about one-sixty-fifth of a grain) of sulphate of strychnine in the nucha. Improvement occurred in twenty-four hours in the tonicity of the muscles. On the third day the cardiac and pulmonary paralysis had so improved that the tracheal râles had ceased. The respiration was more normal and deglutition possible. On the fifteenth day of this treatment and after fifteen injections the patient was considered cured. Dr. Gerasimow[2] relates the case of a child six years of age who had paralysis of the velum, pharynx, larynx, and lower extremities. Six weeks after the commencement of paralytic symptoms subcutaneous injections of strychnine, two centigrammes (or about one-thirty-first of a grain), were given daily. With this treatment the patient improved, and after seven injections of this strength, followed by twelve of one-twenty-second of a grain, the cure was complete.

With such strong testimony in favor of the use of strychnine, it is perhaps remarkable that physicians of experience state that they have not observed any marked benefit from its use in the treatment of diphtheritic paralysis. At a meeting of the New York Clinical Society, held December 23, 1887,[3] Dr. Holt stated that he was yet to be convinced that strychnine possessed any specific value in this disease, though it was of much value as a general tonic. At the same meeting Dr. A. A. Smith stated his belief that tonics and time did more for diphtheritic paralysis than anything else. He had used electricity and strychnine, and had never been able to satisfy him-

[1] *Deutsche med. Wochenschr.*, 1885, No. 19.

[2] *Med. Obozr.*, No. 20.

[3] *New York Medical Journal*, Jan. 14, 1888.

self that electricity did any good, and the effects of strychnine seemed to be not specific, but those of a general tonic. On the other hand, Dr. Thatcher of New York has reported a case in which galvanism was employed on the two paralyzed upper extremities alternately, on each for a week at a time. It was invariably found that the arm receiving the electricity gained more rapidly than the one untreated, the strength being tested by the dynamometer. This test seems to have been conclusive as showing the efficacy of galvanization.

CHAPTER VIII.

PERTUSSIS.

PERTUSSIS is a highly contagious disease attended and manifested by a catarrh of the air-passages. This catarrh gives rise to a cough which does not differ, during the inception and in the declining period, from that in an ordinary catarrh, but during the middle period of the malady is spasmodic. Exceptionally, the system is so mildly affected that the spasmodic element of the cough is lacking through the whole course of the malady or is confined to a brief period. This distinctive symptom—namely, the peculiar cough—has been attributed to the irritating and disturbing action of the specific principle on the nerves which control the muscles of respiration. It is attributed to the impression produced upon the filaments of the pneumogastric, especially upon those of the internal branch of the superior laryngeal nerve, by the mucus which collects in the larynx and trachea, and which is known to contain the contagious principle in abundance. This cough consists in a series of forcible and loud expirations, followed by a noisy and difficult inspiration. Its special character is due to spasmodic contraction of the muscles of expiration, and notably of the small muscles of the larynx, so as to produce narrowing or even closure of the aperture of the glottis. Each paroxysm of the cough usually ends (not always) in the expectoration of viscid mucus. With rare exceptions pertussis affects the same individual but once. Rilliet and Barthez report a case of its second occurrence, and West another case. I have attended two adult patients, both women of intelligence, who stated that they had had previous attacks in early life. Pertussis usually prevails as an epidemic, but is occasionally sporadic, at which time its type is mild. It is highly contagious through the breath of the patient or from exhalations from his surface. Pertussis is probably a disease of antiquity, but there is no clear description of it prior to the sixteenth century. Some have thought that it was alluded to in the writings of Hippocrates, and the Arabian physician Avicenna who lived in the tenth century, in describing the "violent cough of children," which is attended by the spitting of blood and lividity of the face, probably alluded to it (Rilliet and Barthez). Baillon in 1578 described a cough which appeared in Paris, attacked chiefly children, and was so violent that it caused bleeding from the nose and mouth, and often vomiting. Willis in 1682 and Schenck in 1695 also described a convulsive cough which we can apparently identify as pertussis. In the eighteenth century whooping cough was described by many observers in different parts of Europe, among whom we may mention Alberte (1728), Brendel (1747), De Basseville (1752), Forbes (1755), Cullen, Butter, and Danz. In the present century, whooping cough, being eminently contagious and of such a nature that the patients are allowed to mingle in society, is widely disseminated, and epidemics of it are of frequent occurrence.

INCUBATIVE PERIOD.—It is not improbable that this varies in different cases. Some writers believe that it is usually from two to seven days. In one instance I was able to ascertain it accurately. Mrs. B——, having a cough for two weeks, which was afterward ascertained to be that of pertussis, came from Boston to a family in New York. She remained with this family from 2 P. M., January 2, 1879, till the evening, when she left the city. During her stay she held and kissed an infant that was previously well and had never been removed from the floor on which it was born. Pertussis was not at that time prevailing in New York. On the 6th, or four days after exposure, the infant began to cough, and this proved to be the beginning of a severe attack.

AGE.—Most cases of pertussis are between the ages of one year and eight years, but it occasionally occurs in adults and even old people who have not been attacked previously. It is rare under the age of three months, but through the kindness of Dr. Ewing of New York I was enabled to see a new-born infant with pertussis whose mother had had the disease during the two months preceding her confinement. This infant was fifteen minutes old, and during the washing had the first convulsive seizure, which appeared to consist chiefly of a spasm of the laryngeal muscles, with temporary suspension of the respiration, and attended by deep lividity of the features, with some frothing from the mouth. These attacks occurred nearly every hour, with intervals of complete cessation of symptoms. The mucus between the lips finally became stained with blood, and death occurred on the third day. The mother, the intelligent wife of a clergyman, believes that the infant had similar attacks before its birth, for she frequently experienced in the last weeks of gestation what seemed to be strong convulsive movements in the fœtus, the duration of which corresponded with that of the attacks in the infant. A similar case is related by Rilliet and Barthez[1] and another by Keating.[2] These cases throw light on the pathology of pertussis, for they show that the specific principle may enter the blood.

CAUSES.—Climate, race, and nationality do not seem to exert any decided influence on the spread of pertussis. Females are somewhat more liable to be attacked than males and, as we have seen, a large majority of the cases occur between the ages of one and ten years. Letzerich about the year 1870 supposed that he had discovered the cause of pertussis in a microbe, which, received upon the surface of the air-passages in inspiration, increases rapidly and produces the spasmodic cough by its irritating action or the irritating properties which it imparts to the mucus. In the first stage of pertussis he found only the spores of the microbe, and at a more advanced stage, in addition to the spores, he discovered filaments. He placed mucus holding the cryptogam upon the fauces of the rabbit, and witnessed the production of pertussis in this animal. Recently, Burger[3] of Bonn states "that the micro-organism of pertussis is visible with a power of 340 to 600 diameters, appearing as little rods of unequal size. With a higher power it is seen that the rods have the biscuit form. The groups of bacteria are irregularly disseminated or disposed in line, and bear some resemblance to the leptothrix buccalis. The method of preparation is very simple. A small quantity of the expectoration is pressed between two cover-glasses, exposed to the flame of a Bunsen burner to coagulate the albumen; the coloring matter is then added (watery solution of fuchsin or of methyl violet); it is then washed thoroughly in water, or the coloring matter removed by washing in alcohol, the bacteria alone remaining colored. These bacilli are not found in any other expectoration; they are so abundant that it is difficult to contest their action; their frequency is always in direct relation with the intensity of the disease." Dr. Poulet[1] also confirms the statement of a special micro-organism in pertussis from his examinations. In the *St. Petersburgher med. Woch.*, 1887, a "careful observer," Dr. Afanasieff, also states that he has discovered a bacillus in the sputum of pertussis which differs from all other bacilli. It occurs in the form of small rods, single, in pairs, or in chains. The length of the bacillus is 0.6 to 2.2 micromillimetres. Its cultures exhibit peculiar qualities. Inoculated in animals, it produces symptoms like those of human pertussis, and the air-passages of these animals exhibited the appearance of congestion and catarrh. In the *St. Petersburgher med. Woch.*, in 1888, another distinguished Russian observer, Seintschenko, writes that after many experiments he is able to make the following statements: 1. The bacillus of Prof. Afanasieff is specific; 2. Bacilli may be found in the sputum about the fourth day of the disease, in some cases earlier; 3. They multiply in the tissues of the body, and as they increase the severity of the disease increases; 4. The bacilli disappear before the entire cessation of the attacks of coughing, or when the paroxysms are reduced to two or four daily; 5. With complications—such as, for example, a catarrhal pneumonia—there is a great increase in the number of whooping-cough bacilli found in the sputum; 6. A pneumonia developing under these circumstances differs from ordinary attacks of catarrhal pneumonia; 7. The bacillus of whooping cough is of value, not only in etiology and diagnosis, but in the prognosis, of the disease.

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[1] *Treatise on the Diseases of Children.*

[2] *System of Medicine by American Authors:* Lea Bros., Philadelphia, 1885.

[3] *Berlin. klin. Wochenschrift; London Medical Record*, May 15, 1884.

Lesions have been discovered in certain fatal cases which have been supposed to throw light on the etiology of pertussis, but which are now known to have been merely coincidences or results of the disease. Such are congestion of the spinal cord and its meninges, hyperæmia of the pneumogastrics, and tumefaction of the tracheo-bronchial glands, which it was claimed produced the spasmodic cough by compressing the recurrent laryngeal nerve.

Pathological Anatomy.—Catarrhal inflammation of the air-passages is uniformly present. It occasionally occurs on the mucous surfaces of the nostril and pharynx, but is often absent from these parts. In the majority of patients the inflammation affects the surface of the glottis and that below the glottis. Herff examined his own larynx during paroxysms of pertussis. He observed a moderate inflammatory hyperæmia of the respiratory tract during the entire course of the disease. The inflammation extended from the posterior nares to the bifurcation of the trachea, but was most marked in the following locations: over the cartilages of Santorini, Wrisberg, and the arytenoid, and the posterior wall of the larynx, between the vocal cords and the epiglottis, and on the under surface of the epiglottis. The vocal cords themselves were not affected. During the paroxysm a pellet of mucus was observed upon the posterior surface of the larynx on a level with the glottis, and when this was removed the cough ceased. Irritation of this part of the larynx uniformly excited a cough. Sometimes certain alveoli are found distended by a thick muco-pus, producing an appearance like minute tubercles.

A common lesion found in the lungs of those who have perished with this malady is emphysema, affecting chiefly the peripheral portions of the upper lobes. It is usually vesicular emphysema, occurring from over-distension of the air-cells, but in some instances the air has escaped into the connective tissue, causing interstitial emphysema. According to my recollection of fatal cases which have occurred from time to time in the institutions of New York, and in which I have made post-mortem examinations, the upper lobes were exsanguine and inflated to nearly the fullest extent possible within the thorax, while other portions of the lungs presented areas of pneumonic or more or less complete atelectatic solidification. Pneumonia, atelectasis, and small extravasations of blood in the lungs are, indeed, common lesions. Hyperplasia of the bronchial glands is also common, and hyperplasia has also been occasionally observed of other lymphatic glands, as the mesenteric. An ulcer under the tongue which observers have frequently noticed is now attributed to the pressure of the tongue on the lower incisors during the cough.

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[1] *La Scalpel; London Medical Record*, May 15, 1884.

In fatal cases small extravasations of blood in or upon the brain are common, as is also passive congestion of the sinuses, veins, and capillaries, meningeal and cerebral, attended with more or less transudation of serum within the ventricles of the brain and between the meninges. Large dark and soft clots, and occasionally some that are white or yellow, are common in the intracranial sinuses, especially if, as often happens, death have occurred in convulsions which supervened upon the severe spasmodic cough.

SYMPTOMS.—Pertussis consists of three stages: first, that of catarrh of the air-passages; secondly, the stage of spasmodic cough, or, for brevity, the spasmodic stage; thirdly, the stage of decline.

The *first period* is characterized by the symptoms of coryza and bronchitis, which present nothing peculiar or different from ordinary catarrh of the same parts, unless occasionally the cough be more frequent and teasing. Trousseau has known it to be repeated forty or fifty times per minute. The eyes present a moderately suffused appearance, and there is sneezing, with defluxion from the nostrils, but less than in the commencement of measles. The cough, which begins as soon as the catarrh affects the larynx, is accompanied by little or no expectoration. The pulse and respiration are moderately accelerated, and such other symptoms as commonly accompany catarrh of a mild grade are present—to wit, increased heat of surface, thirst, and impaired appetite.

The duration of the first stage varies in different cases. In severe whooping cough it may last only two or three days, and in mild cases be protracted to five or six weeks. It may be absent especially in very young infants. We have alluded above to the new-born infant, in whom there is no first stage, a glottic spasm occurring soon after birth. The first stage commonly ends in from eight to fifteen days. In fifty-five cases observed by Dr. West its average duration was twelve days and seven-tenths of a day. It is stated above that the first stage in rare instances continues during the entire course of pertussis; at least no spasmodic cough occurs. In two such cases which I now recall to mind, both girls, the inflammatory symptoms abated somewhat after the first few days, and an occasional easy cough remained, like that of simple bronchitis, and it continued during a period corresponding with the ordinary duration of pertussis. The diagnosis would have been doubtful, except for the occurrence of pertussis, with its regular stages, in other children of the same families.

Second Period.—This may commence quite abruptly, but ordinarily its beginning is gradual. While the cough commonly has the character present in the first stage, it is now and then observed to be more severe and spasmodic, especially at night and when the patient is in any way excited. The spasmodic element increases, so that in the course of a week all doubt as to the nature of the disease is removed.

The severity of the cough in the second stage varies considerably in different cases. It sometimes commences quite abruptly, with little warning, but commonly there is premonition of it, and the child endeavors to repress it. He experiences a tickling sensation in the throat or median line of the chest, or a feeling of constriction. He leaves his playthings and rests his head on his mother's lap or takes hold of some firm object for support; his face has a grave or even anxious appearance, while the pulse and respiration are somewhat accelerated. Immediately the cough begins. It consists in a series of short and hurried expirations, which expel a large part of the air contained in the lungs, followed by a hurried inspiration, which is difficult and noisy on account of the spasmodic contraction of the laryngeal muscles and narrowing of the glottic aperture. The sound which accompanies the inspiration, and which is often absent, especially in infants, is designated the whoop. The forcible expirations and difficulty experienced in expelling the air from the lungs on account of the constriction of the glottis afford explanation of the emphysematous distension of the air-cells in the upper lobes which we have seen is so common in severe pertussis.

There may be a single series of expirations terminating in the manner stated, but often there are several such series embraced in a paroxysm. The cough commonly ends in the expulsion of frothy mucus from the bronchial tubes, and sometimes in vomiting. During the cough there is temporary arrest of blood in the lungs, leading to congestion in the right cavities of the heart and throughout the systemic circulation; therefore the face is flushed and swollen, and occasionally hemorrhage occurs under the conjunctiva or from one of the mucous surfaces. The most frequent hemorrhage is epistaxis. When the cough ceases, the normal respiration is restored, the fulness of the vessels immediately abates; but often puffiness of the features is observed, due to serous infiltration of the subcutaneous connective tissue, and continuing for days or weeks during the period when the cough is most severe. The paroxysm lasts from a quarter to a half or even a whole minute, and in that time, in cases of ordinary severity, there are often as many as fifteen or twenty series of expirations.

At the close of the paroxysm, if there be no complication, the symptoms soon abate; the temperature, pulse, and respiration become normal, and there is no evidence of disease. The cough in the second stage is much more frequent in one case than another. At the height of this stage it is generally more severe if it occur at long intervals than when frequent. During the weeks in which pertussis is most severe there is, on the average, about one paroxysm of coughing in each hour.

The cough increases in severity till the third week of the second stage, or the thirtieth to the thirty-fifth day of the disease, after which it remains stationary for a certain time. It is apt to be more frequent in the night than day-time. Sometimes it occurs while the child is quiet; it may even awaken him from sleep, but it is often also produced by mental excitement or by physical exertion. Anger or fright gives rise to it, and therefore the child is likely to cough when being examined by the physician or when his wishes are not complied with. The ordinary duration of the second stage is from thirty to sixty days. It may, however, be considerably longer or shorter than this.

The *third stage*, which commences at the time when the spasmodic cough begins to abate, is short, not continuing longer than two or three weeks. A protracted stage of decline indicates some complication. While the sputum in the second stage is mucous and frothy, that in the third stage is more opaque and puriform.

In the third as in the second stage, if there be no complication, the pulse and respiration in the intervals of the paroxysms are nearly or quite natural. Febrile excitement may, however, now and then occur from trifling causes, or, indeed, without any apparent cause. The digestion and the general health in uncomplicated pertussis remain unimpaired, with the exception of more or less emaciation, which is likely to occur in all but the mildest cases in consequence of the frequent vomiting. After complete recovery it is not unusual for the spasmodic cough to reappear at times for one or even two years. The cough of ordinary simple laryngitis or bronchitis assumes this character.

COMPLICATIONS.—These, like the symptons, are chiefly of a twofold character—to wit, inflammatory and neuropathic. From the nature of the cough in pertussis, it would naturally be supposed that the spasmodic affection which is now designated internal convulsions, and which is characterized by spasm of certain muscles of respiration, would be a frequent complication. It does sometimes occur in young children, but it is not common. Clonic convulsions affecting the external muscles are, on the other hand, not infrequent. They occur chiefly in the second stage, when the cough is most severe, and in infancy much more frequently than in childhood. They are likely to be general and severe, or, if not of this character at first, to become such. The convulsions commence in most instances in or directly after the paroxysm of coughing, but they sometimes occur in the interval when the child is quiet.

Rilliet and Barthez remark: "Almost all infants succumb to this complication, ordinarily in the twenty-four hours which follow the first attack; nevertheless, life may be prolonged during two or three days" (article *Coqueluche*). In my own practice this complication usually ended fatally before bromide of potassium and chloral were employed, but with the proper use of these agents it can often be arrested. In the month of June, 1867, I was attending a little girl two years and four months old who had reached the fifth week of pertussis when she was seized with general clonic convulsions. The mother, who was requested to keep a record of the number of convulsions, stated that there were twenty in all occurring within forty-eight hours. They affected both sides, the shortest lasting only three or four minutes, the longest seventy-five minutes. The treatment in this case, which eventuated favorably, will be noticed hereafter.

In those who die of convulsions occurring in whooping cough the most constant lesion is congestion of the cerebral veins and sinuses, often with transudation of serum. This congestion is due in part to the cough which precedes the convulsions and in part to the convulsions themselves. At the autopsies which I have made of two infants who died in hospital practice from whooping cough, accompanied by convulsions, all the cerebral sinuses were filled with clots, which were generally soft and dark; but in the lateral sinuses clots were found which were light-colored. The light color of a clot, either in a vein or sinus, indicates its ante-mortem formation.

The gravity of the convulsive attack can be ascertained by observing whether the patient readily recovers consciousness. Its return indicates that there is no serious congestion. On the other hand, great drowsiness remaining or a semi-comatose state indicates persistent congestion, and perhaps even the formation of clots in the sinuses of the brain. Death from convulsions is usually preceded by coma. Occasionally meningeal apoplexy supervenes upon the congestion, and death is immediate.

The most frequent inflammatory complications are bronchitis and pneumonitis. Inflammation of the bronchial tubes of a mild grade, we have seen, is a common accompaniment of pertussis, but when it extends to the minuter tubes or becomes so severe as to cause acceleration of respiration, it is properly a complication. Both bronchitis and pneumonitis, occurring as complications, are developed, with few exceptions, in the second stage. Bronchitis is accompanied by accelerated respiration and pulse and increased temperature. The danger is proportionate to the amount of dyspnœa.

Pneumonitis is a less common complication than bronchitis, but it occurs more frequently in pertussis than in any other constitutional malady of early life, excepting measles. The congestion which results and remains in the lung when the cough is frequent and severe favors the development of pneumonia. The symptoms and physical signs which accompany this inflammation and serve for its diagnosis are the same as in the primary form of the disease, and are described elsewhere. Bronchitis or pneumonia usually moderates the severity of the spasmodic cough, for when the inflammatory element in pertussis increases the spasmodic abates. On the abatement of the inflammation, however, the cough usually regains its former convulsive character. The fact may be stated in this connection that any complication or intercurrent disease which is attended by decided febrile reaction ordinarily renders the cough for the time less spasmodic.

The occurrence of bronchitis or pneumonia is shown by the elevated temperature, acceleration of pulse and respiration, short and frequent cough. These symptoms do not cease so long as the inflammation continues, whereas in uncomplicated pertussis the patient seems nearly or quite well between the coughs. In pneumonia the respiration is accompanied by the expiratory moan, and in both bronchitis and pneumonia there is more or less depression of the inframammary region during inspiration. These symptoms, in connection with the physical signs, render diagnosis in most instances easy. Although the general character of the cough is changed, a cough now and then occurs, even when the inflammation is pretty severe, sufficiently spasmodic to indicate the nature of the primary affection. Capillary bronchitis and pneumonia are always serious complications.

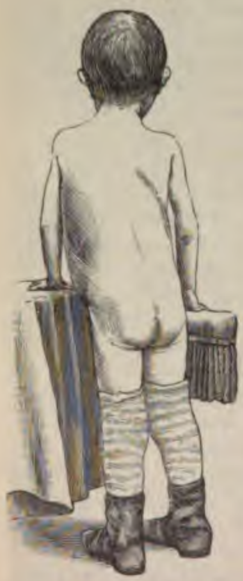
Not only is more or less emphysema a common complication of severe pertussis, but bronchiectasis also occurs in certain cases, due to the same conditions. Emphysema is a common lesion in young and feeble infants, even when there is no history of any previous severe disease of the respiratory organs. I have found it one of the most common lesions in infants of feeble constitutions who die in the hospitals and asylums of New York, but it is usually interstitial and confined to a small part of the upper lobes. It is not accompanied by that general distension of the alveoli and consequent enlargement of the lobes which occur in the emphysema of pertussis. Its chief cause in these feeble and wasted infants appears to be impaired nutrition and change in the molecular state of the pulmonary tissue. The same molecular change often occurs in severe and protracted pertussis, and therefore serves as an additional and efficient cause of the emphysema.

The following was a not unusual case of this disease as it occurs in the tenement-houses and asylums of New York. At the meeting of the New York Pathological Society, October 14, 1868, I exhibited emphysematous lungs removed from an infant who died at the age of nineteen months at the commencement of the fourth week of pertussis. Death occurred from thrombosis in the lateral sinuses of the cranium, resulting from the severe spasmodic cough, eclampsia, and feebleness of the circulation, as the infant was previously in a reduced state from chronic entero-colitis. At the autopsy the superior lobes of both lungs were found exsanguine, doughy to the feel, and enlarged so as to rise above the level of the other lobes. The resiliency and elasticity of the lung-tissue in these lobes were evidently greatly impaired, and their air-cells in a state of over-distension. The other lobes were healthy, except that one of them was the seat of catarrhal pneumonia. In this case there had been no disease affecting the respiratory apparatus previous to the pertussis, so that the incipient vesicular emphysema was referable to the severe cough and impaired nutrition of the lungs.

Occasionally we meet cases of severe pertussis in which, while there is over-distension of the alveoli of the upper lobes, collapse occurs over a greater or less extent of the lower lobes. Collapse, like emphysema, may continue for weeks or months subsequently to pertussis, and then gradually disappear, but in the following case, rare in my experience, it was permanent: John O'Neil, aged five and a half years, was brought to the Bureau for the Relief of the Out-door Poor in New York in December, 1876. He lived in the underground basement of a tenement-house, and was supported by charity, except at intervals, when his father, who was dissipated, could obtain work. At the age of fifteen months he had a glandular swelling on the right side of the neck, which suppurated, and three months later one on the opposite side, which also suppurated. At the age of two and a half years he had bronchitis, the cough of which did not abate till two months subsequently. When near the age of three years he had measles, and the cough from this disease lasted three or four months. In the summer of 1875, or about one year subsequently to the measles, he contracted pertussis, which was severe, but was allowed to run its course without treatment. It lasted four months, never, however, confining him to bed or materially impairing his appetite. One morning about the close of the second month of the malady the parents first observed depression of the right side of the thorax. This gradually increased a few weeks, and has been permanent. The parents stated that he had never been confined to the house or without appetite except during the week of measles.

Since his recovery from pertussis he has had his usual appetite and general health, but crying or excitement commonly brings on a pretty severe cough. The depression of the thorax, examined in front, begins quite abruptly in the line of the left costo-chondral articulations. Circumferential measurement of the left side from the middle of the sternum to the spine, the tape lying a little below the nipple, gives eleven and a half inches, while corresponding measurement of the right side gives seven and a half inches; pulse 136, sounds of the heart normal; respiration 44. On auscultation over the right side of the chest we observed bronchial respiration and a feeble bronchophony, with perhaps slight vocal fremitus. The accompanying figure is from a photograph by Mr. Mason, photographer to Bellevue Hospital. My first impression on observing this case was that it was one of unexpanded lung which had been compressed by a pleuritic effusion, but it is seen that the history points clearly to pertussis as the cause of the deformity. The depression occurred somewhat suddenly when the cough was most severe and when there was no fever, loss of appetite, or other symptom of pleuritis. The patient had not presented any marked evidence of rachitis, but was decidedly strumous.

FIG. 28.



Pertussis is sometimes complicated by the eruptive fevers. There does indeed seem to be some affinity between it and measles, so that many epidemics of the two have been observed at about the same time. During my term of service in the New York Foundling Asylum, in May, 1878, measles and pertussis prevailed in the wards at the same time. Eighteen of the children who were having pertussis contracted measles, and the Sisters, who were very intelligent and faithful observers, and were requested by me to notice the effect of the complication, stated that with few exceptions the severity of the whooping cough was increased during the continuance of the exanthem. This is contrary to the general belief of the effects of intercurrent febrile diseases.

Diagnosis.—During the period of invasion it is impossible to diagnosticate pertussis. Its nature can only be conjectured from a known exposure or from the epidemic occurrence of the disease. In the second stage, which is characterized by the spasmodic cough, diagnosis is ordinarily easy, and often the parents are able to announce the nature of the disease when the physician is called. Still, a mistake is sometimes made: a spasmodic cough very similar to that of pertussis occasionally occurs in other maladies. Young infants with bronchitis frequently experience great difficulty in the expectoration of mucus, which collects in the air-passages and provokes a suffocative cough. The following facts will aid in making the diagnosis: Bronchitis, accompanied by a suffocative cough, is an acute disease, and the cough occurs at an early period, usually in the first week. It lacks the inspiratory sound or the whoop, and is associated with constantly accelerated respiration and well-marked febrile symptoms, dependent on the inflammation. Moreover, the cough is occasionally suffocative, according to the amount of mucus in the tubes. The spasmodic cough of pertussis, on the other hand, is preceded by the stage of invasion, and it occurs only in the second stage, when the febrile symptoms have abated. Again, the suffocative cough of bronchitis rarely ends in vomiting, which is common in the cough of pertussis.

The only other disease with which there is much likelihood of confounding pertussis is bronchial phthisis. The points of differential diagnosis are the following: the one epidemic and spreading by contagion, the other noncontagious and isolated; the one embraced in three distinct stages and much shorter, the other chronic and presenting no stages, but commencing with mild, non-febrile symptoms and progressively becoming more severe; in the one an absence of symptoms in the intervals of the cough, provided that there be no complication, in the other constant symptoms, such as are common in tubercular disease. The previous health and the presence or absence of a tubercular cachexia should be considered in determining the nature of the disease. Usually in bronchial phthisis the lungs are also affected, so that auscultation and percussion may furnish positive proofs of the nature of the cough.

The attacks of suffocative cough which are produced by the lodgment of a foreign body in the larynx or lower down in the air-passages bear a close resemblance to those of pertussis. The diagnosis can be made by the history, for in the one case there is a preliminary catarrhal stage, and in the other the cough begins abruptly, and usually after the known swallowing of the offending substance, which produces dyspnœa and a spasmodic cough as soon as it enters the larynx. The presence of the body can also be determined in a large proportion of cases by the laryngoscope and auscultation.

Prognosis.—A larger proportion doubtless recover under the better therapeutics of the present time than in former years. According to Hirsch (ii. p. 105), 72,900 persons perished from this disease in England and Wales between 1848 and 1855, or 1 in every 40 who died; and Wilde's reports show that it stands fifth as regards mortality among the epidemic diseases of Ireland. In New York City, during the half century ending with 1853, 4840 died of pertussis, or 1 died from this disease in every 76 of deaths from all causes.

As a rule, the older the child the better the prognosis. Young infants may die of suffocation due to the glottic spasm. Eclampsia with extreme passive congestion of the encephalon is a not infrequent complication in children under the age of five years, and it is apt to terminate fatally. It may, however, be averted in most cases by proper treatment when threatening. In rare instances death may occur in or immediately after a paroxysm of coughing, in consequence of rupture of a cerebral or meningeal vessel and the effusion of blood, or from stasis and coagulation of blood in the venous system, especially if convulsions have supervened upon frequent and protracted paroxysms of coughing. Other complications which are likely to arise under conditions which favor their development, and which greatly increase the danger and render the prognosis unfavorable, are capillary bronchitis, pneumonia, diphtheria, and in the summer season intestinal catarrh.

Feebleness of system and antecedent and accompanying chronic disease increase the danger. Pertussis sometimes produces so much emaciation and loss of strength, in consequence of the severity and frequency of the cough and the repeated vomiting, that intercurrent diseases which in favorable states of the system would probably end in recovery are very apt to prove fatal.

I usually inform the family that the patient is doing well if he seem entirely well between the paroxysms; but if he appear ill, whether with somnolence, fretfulness, fever, loss of appetite, accelerated breathing, or diarrhœa, he is not doing well, and probably has some complication which requires attention.

Treatment.—In the catarrhal stage the treatment should be the same as in mild idiopathic bronchitis. Demulcent and soothing cough mixtures are required. Care should be taken to employ nothing which reduces the strength or impairs the general health. If there be much bronchitis with accelerated breathing and frequent cough, mild counter-irritation to the chest and the use of the oil-silk jacket are proper.

Therapeutic measures are chiefly indicated in the second stage or that of convulsive cough. Proper treatment may control the severity of the cough, and abridge the duration of the second stage, and prevent or control complications. Pertussis has received a great variety of treatment. The enumeration of the medicines and modes of treatment which have had their season of repute and been employed by intelligent physicians would occupy too much time. The treatment should vary in some respects according to the case, but a small number of medicines suffices even in the most severe and obstinate forms of the malady. Knowledge and appreciation of the pathological state in pertussis assist us to the choice of the proper remedies. The specific principle of pertussis produces but little depression of the vital powers. It does not impair the appetite by its direct action on the nutritive function, nor does it produce those profound blood-changes which we observe in scarlet fever and diphtheria. It affects the system injuriously by the severity of the cough, the vomitings and consequent loss of nutriment, and the complications which frequently occur, some of which involve fatal consequences.

Remedies are required which diminish the sensitiveness of the laryngotracheal surface, which destroy the specific principle in those parts where the local manifestions of the disease occur, or control its action; that is, in the larynx and trachea. The use of inhalations is at once suggested as most likely to fulfil the indications, since by inhalation the medicine employed is brought into immediate contact with the parts which are chiefly concerned in the disease.

Carbolic Acid.—During an epidemic of pertussis a few years since in the New York Foundling Asylum, after trial of the older remedies without any marked result, carbolic acid, half a drachm to eight ounces of glycerin and water, was employed by inhalation from three to six minutes, and at intervals of two to six hours according to the severity of the cough. The result was apparently better than with the other remedies, since the cough became less frequent and severe. Carbolic acid seems to have an anæsthetic effect on the laryngo-tracheal surface. It is also an efficient antiseptic and germicide agent, so that if inhaled frequently it probably destroys the specific principle in the mucus and epithelial cells of the air-passages. It has been in my practice conveniently employed in the croup-kettle. Three teaspoonfuls of the saturated solution of carbolic acid are added to water sufficient to cover the bottom of the croup-kettle to the depth of two inches, and when it is brought nearly to the boiling-point, the vapor is inhaled a few minutes every hour or second hour through the tube. If an equal quantity of the oil of eucalyptus be added, the inhalations are more agreeable and the germicide effect is probably increased. Dr. Keating[1] recommends the following formula for inhalation:

℞. Acidi carbolici cryst., gr. iij;
Sodii biborat.,
Sodii bicarb., *āā.* gr. x;
Glycerinæ,
Aquæ, *āā.* ℥j.

An alkali, as in the above mixture, is believed to render the mucus more fluid, and water, even when not medicated, increases its fluidity and renders expectoration more easy. Pick also highly recommends carbolic acid in the treatment of pertussis (*Archiv f. Kinderheilk.*, 1886), and believes that when not effectual it is too much diluted. He adds fifteen to twenty drops to a roll of cotton, which is introduced into a mask. The patient inhales the vapor of the gas several times each day, and the cotton wad is renewed three times. The duration and severity of the disease were diminished by the inhalation, and no ill results occurred in any case. Miller has also used carbolic acid internally in doses of one minim in children over the age of five, with, he states, good results; but its use by inhalation appears to be equally or more effectual, and is devoid of the risks which attend its internal use (*Medical Register*, 1888).

Cocaine.—This has been quite largely used as an application to the throat on account of its anæsthetic effect, but its action is evanescent, so that in order to obtain the full benefit from its use it is necessary to apply it often. Labrie states that the repeated application to the throat of a 5 per cent. solution immediately diminishes the number of paroxysms (*Lond. Med. Rev.*, 1888). Holt, in discussing the safety of its use (*N. Y. Med. Jour.*, 1888), states, "1st. It must be used with great caution in young children under all circumstances; 2d. The spray is never to be recommended, since an uncertain quantity is given; 3d. Solutions stronger than 4 per cent. should not be used in children under two years; 4th. In cases where it was tried he failed to see any notable benefit." Probably cocaine will not come into general use, because frequent applications would be necessary in order that its effect be continuous, and this would apparently be dangerous; still, it might be occasionally used in order to obtain temporary respite from the cough when it involves danger in consequence of its frequency and severity.

Antipyrine.—This agent is now largely used, and many physicians have written in its favor. Sonnenberger regards it as a specific (*Therapeut.*

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[1] *Medical News*, Feb. 28, 1885.

Monatschrifte, 1888). He prescribes it in doses of as many centigrammes (one-sixth grain) as the child is months old, and as many decigrammes (one and a half grains) as it is years old, three times daily. He says that the earlier it is employed the better is the result. Genser administers only one and a half grains daily for each year of the age, and he found that it diminished the frequency and severity of the cough (*Algemeine Med. Cent. Zeit.*, 1888). Laborderie reports the complete cure of pertussis by the use of antipyrine in twelve to sixteen days. He says: "(1) Children take antipyrine without difficulty, and as a rule easily bear its effects; (2) The spasmodic condition is rapidly calmed, and in a few days the disease declines; (3) Its action is so prompt and free from accidents that it becomes a valuable remedy in a malady which may be of prolonged duration and give rise to many complications" (*Bull. gén. de Thérap.*, 1888). In my practice antipyrine has also in some cases been a very important remedy, reducing the severity of the paroxysms. I have administered it in small or moderate doses every third or fourth hour in combination with an alcoholic stimulant. Antipyrine is especially useful in cases attended by fever.

Quinine.—The use of quinine in whooping cough was strongly recommended by Binz, who attributed the good effects which he had observed to its germicide action. It has been employed with apparently good results, both locally and internally. Kolover prescribes the following solution as a spray: ℞. Quiniæ sulph., gr. 50; Acidi sulphur., gtt. 30; Aquæ destillat., ℥5½. The fauces are sprayed with this every two hours for the first three days, and three hours for the rest of the week, when treatment is no longer necessary (*L'Union Méd.*, 1887). Bachen employs insufflation into the nostrils of fifteen grains of a finely triturated powder of twenty parts of quinine and one of benzoin (*Lond. Med. Rec.*, 1887). Swett also prescribed the insufflation of quinine morning and evening, and observed improvement after the first day. Forchheimer and the late Prof. Rochester have likewise recommended the local use of quinine. The internal use of quinine has been supposed to be useful by diminishing reflex irritability (Schlakow and Eulenberg). It is undoubtedly a useful remedy in those common cases in which febrile symptoms arise from bronchitis or broncho-pneumonia.

Paulet[1] recommends the evaporation, over a suitable fire, of

℞. Spirits of thymol,	grammes	10
Alcohol,	"	250
Water,	"	750

Keating also recommends the same agent in the follwing formula:

℞. Thymol,	gr. xv;	
Alcoholis,	℥iij;	
Glycerinæ,	℥ss;	
Aquæ,	℥xxxiv.	Misce.

Internal remedies, formerly much used, now occupy the second place in the therapeutics of pertussis. Belladonna has been largely employed, since it appears to diminish the spasmodic element in the cough of pertussis. Brown-Séquard, in remarks made before the United States Medical Association in May, 1860, maintained that the duration of pertussis, so far as its nervous element is concerned, might be abridged to a few days by doses of atropia sufficiently large to cause toxical effect; but in one case which I saw in consultation, in which one teaspoonful of tincture of belladonna was given by mistake to a child of about three years, the subsequent cough, though mild, did e its spasmodic element. Children require a larger proportionate dose of onna than adults, and it can be safely administered in gradually increas- ses until physiological effects are produced, when some mitigation in ough may be expected. Probably the action of the drug is on the atory centres in the medulla, and not directly on the muscles of respira- The effect of belladonna in controlling the spasmodic cough is most ed when physiological symptoms are produced, and some children require r doses than others. Thus I gradually increased the doses of belladonna elve drops for a child of three and a half years who had severe pertussis, out producing the characteristic efflorescence, while smaller doses from ame bottle produced this effect in older children. Rarely I have discon- d the belladonna on account of diminished flow of urine, which this t may or may not have produced, and very rarely on account of suddenly loped muscular weakness, which I had reason to think the belladonna ed. This occurred in the case alluded to above, in which twelve drops e tincture were given, so that the muscles seemed flabby and the trunk ead were supported with difficulty. The tincture of belladonna is con- nt for use, and most of that in the shops is active and reliable. The which I ordinarily found to be sufficient when prescribing belladonna ertussis, and which also produced efflorescence, were as follows: to a of two years three drops, and to one of six or eight years eight or ten s, morning and evening. I always, however, commenced with a smaller ber, and continued to administer the dose which produced the local effects led to, unless the cough were moderated by smaller doses. In the majority ases I have noticed no decided effect till the rash was produced, when the ptoms improved, the cough becoming less frequent or less severe. By belladonna treatment the spasmodic stage may not only be rendered mild, be abridged to two or three weeks. In some cases the severe cough begins ield almost immediately under full doses of this agent, but in other cases ontinuance for some days is necessary, with other remedies as adjuvants, re there is any appreciable benefit from its use. But since the germicide ment of pertussis has come into use, it is probable that belladonna will ntirely superseded by those agents which are believed to exert a destruct- ffect on the supposed cause.

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[1] *London Medical Record*, May 15, 1884.

ulphur.—Much benefit is said to result from fumigating the room pied by the patients with burning sulphur. The children having the se are attired in clean clothes and removed, and the room which they occupied, containing the furniture, clothes, and toys, is fumigated five s with burning sulphur, after which the doors and windows are thrown The children sleep in the same room during the following night. diate improvement is said to follow. This treatment of pertussis is mended by Manby, Gelhert, Mohn, and others.

he distinguished Brazilian physician Moncorvo advises, and uniformly ys, local treatment with a solution of resorcin. In an interesting paper before the Pediatric Section of the Ninth International Medical Con- in 1887 he states that he employs resorcin as a local antiseptic on nt of its slight irritating properties, its great solubility, and its absence or. Beginning with a 1 per cent. solution, he had increased it to 8 per He first applies to the periglottic region a 10 per cent. solution of chlorate of cocaine, which diminishes the reflex excitability of the laryn- mucous membrane and renders the paroxysms less frequent, and then es the resorcin.

leyer recommends the use of the peroxide of hydrogen (H_2O_2) as the powerful antiseptic and germicide in existence. He sprays the laryngeal *with the following:*

℞. Ch. Marchand's peroxide of hydrogen (15 vol. chemically pure), ℥j;
Aquæ, ʒv.

At the same time the nares are irrigated with the following:

℞. Peroxide of hydrogen, ℥ij;
Aquæ, ℥iij. Misce.[1]

Previously, Dr. B. W. Richardson had stated that he obtained good results from drachm doses of the peroxide given five or six times daily.[2]

Cresoline, a product of coal-tar, having the formula $C_6H_5CH_2O$, vaporized in the nursery by a flame underneath, also has its advocates.

All the remedies mentioned above have apparently been sufficiently employed to justify the belief that when judiciously employed they diminish the severity and duration of the paroxysmal stage of pertussis. Additional observations are required in order to determine the comparative efficiency of these agents.

Since the paroxysms are likely to be more severe at night, and the patient consequently is deprived of the required sleep, a medicine is needed which will procure some hours of rest and thereby diminish the number of paroxysms. For this purpose the hydrate of chloral is especially useful, given in doses of two to five grains according to the age, and perhaps repeated. It does not seem to me that chloral exerts any marked influence upon the cough; it appears to be useful chiefly in the manner stated—to wit, by procuring prolonged sleep.

One of the chief dangers from pertussis we have seen to be the occurrence of passive congestion of organs, especially of the brain, with the liability to hemorrhages, serous effusion, and eclampsia. This is in great part prevented by the action of the medicines mentioned above, which diminish the severity of the cough or its frequency. But when there are great and frequent congestions of the nervous centres, producing eclampsia or premonitions of eclampsia, the use of one of the bromine compounds is indicated for its prompt and decided action in averting the danger. Even if the symptoms be not urgent, its tranquillizing effect, and especially its prompt action in diminishing reflex irritability, render it one of the most useful agents in pertussis. If there be sudden twitching of the muscles, marked stupor, headache or fretfulness, or adduction of the thumbs across the palms of the hands during the cough, I never fail to give the bromide of potassium in sufficiently large and frequent doses; and now eclampsia occurs much more rarely in a case which I treat from the commencement than in former years.

The complications of pertussis require prompt treatment. Whenever the child feels ill between the paroxysms, he should be carefully examined, and some complication will probably be found which requires treatment. If the bronchitis have increased so as to become a complication or pneumonia have arisen, the whole chest should be covered with a light flaxseed poultice containing one-sixteenth part of mustard, while quinine and ammonia with alcoholic stimulants are given at regular intervals. Cerebral accidents are best arrested by the warm foot-bath, cold to the head, and by the bromide and chloral.

Diphtheria not infrequently supervenes as a complication in a locality where it is endemic or epidemic, and if mild it is often overlooked. Recently I have seen a case in which diphtheria complicating pertussis had continued four days, without being recognized by the attending physician, the symptoms being attributed to other causes. The diphtheritic patch in these cases

[1] *Omaha Clinic*, 1888.

[2] *Asclepiad*, 1883.

appears upon the well-known sore under the tongue, in addition to its occurrence upon other parts. The secondary form of diphtheria requires the same treatment as the primary form.

Hauke in 1862 published experiments which showed that both carbonic acid and ammoniacal vapors when inhaled increase the cough, while the inhalation of oxygen produced no cough and was agreeable to the patient. Hence children in close and crowded apartments suffer most severely from pertussis, and those who are taken to parks or the country, where vegetation absorbs the carbonic acid, not only obtain benefit from the general invigorating influence, but also as regards the cough. The fact that fresh and pure air benefits the cough has indeed long been known, and has influenced practice, for patients are almost universally allowed to be much of the time in the open air and are taken to the parks and upon excursions. Nevertheless, caution is this regard is required, for exposure in wet weather or to sudden changes of temperature is very likely to develop bronchitis or pneumonia.

Prophylaxis.—Pertussis is very contagious, and it appears to be, in nearly all instances, if not in all, contracted by inhaling the breath of the patient. I have never observed a case in which it seemed to be communicated through a third person, and it is not, I think, usually contracted by children living in the same house if there be no personal contact. There is not, therefore, that urgent need of personal disinfection and of caution on the part of the physician and nurse in their subsequent intercourse with healthy children, as in the case of the eruptive fevers.

CHAPTER IX.

MUMPS.

SYNONYMS.—*Parotitis, Parotiditis.*—Mumps is a constitutional or blood disease with local manifestations. It occurs chiefly in childhood, youth, and early manhood, cases being rare in infancy and old age. Its chief characteristic, by which it is readily recognized, is inflammation of the salivary glands, causing swelling and tenderness.

ETIOLOGY.—This disease is highly contagious, and it commonly occurs as an epidemic. It is usually communicated through the air, which is tainted by the breath or by exhalations of a patient, but cases are recorded in which it seems to have been communicated by a third person or by infected articles. Thus Roth relates a case in which it appears to have been communicated by a physician, and another case in which it was attributed to the use of bedding in which a patient with mumps had slept (*Bost. M. and S. Jour.*, 1887).

Mumps is probably a microbic disease, but the nature of the microbe has not been clearly ascertained. The investigations of Ollivier are confirmatory of those of Capelan and Charin on the occurrence of peculiarly-shaped micrococci in the blood and urine of patients with mumps (Haldemann, in the *Jour. Am. Med. Assoc.*, 1887). Pasteur found in the blood in mumps rod-shaped bacteria one millimetre broad and two millimetres long, but attempts to inoculate animals were fruitless (*Annual of Med. Sci.*, vol. i., 1889).

INCUBATION.—Dr. Dukes states that the incubative period appeared to be from sixteen to twenty days in 32, and perhaps 34, of 42 cases. Henoch believes that the incubative period is usually about fourteen days. Goodhart relates a case which occurred fourteen days after exposure, and in two others the incubation appeared to be twenty-one days. Ringer says that the incubative period varies from eight to twenty-two days. Flint says that the incubation varies from ten to eighteen days. Bristowe states that the average is about fourteen days; and his opinion, I think, is correct.

SYMPTOMS.—Mumps begins with languor and fever, the temperature in some cases rising to 103°, and if the fever be considerable, headache and vomiting are common. In a few hours, usually as early as the first visit of the physician, the patient complains of pain and tenderness in the depression below one ear and posterior to the ramus of the jaw. Notwithstanding the fever, the features are often pallid. Along with the pain and tenderness swelling begins in the site of the parotid gland on one side, and more frequently, it is said, on the left than right. In most instances the swelling soon begins upon the opposite side, so that the disease is bilateral. Exceptionally, it begins on the two sides simultaneously. Rarely only one side is affected. The swelling gradually increases; it fills the depression under the ear, extends forward and upward upon the cheek, and downward to a greater or less extent upon the neck. It reaches its maximum from the third to the sixth day. The most prominent point at this time is immediately underneath the lobule of the ear, which is pressed outward by the swelling of the gland. The tumor yields on pressure, but is elastic and tense, and the fulness immediately returns when the pressure is removed. The skin covering it preserves its normal appearance or it presents a faint blush. The fever, more or less intense, does not usually continue more than two to four days, but occasionally it remains longer. The pressure which movements of the jaw and of the pharyngeal muscles produce on the gland renders mastication, swallowing, and even speech, painful and difficult. The submaxillary glands, and also the sublingual, are occasionally involved, so that the features are greatly disfigured by the swelling. The swelling is at its maximum between the third and sixth days, after which it begins to decline, and between the tenth and twelfth days it has entirely disappeared.

Occasionally, during an epidemic of mumps we observe cases in which the parotids are but slightly or not at all affected, and the chief manifestations of the disease are in the submaxillary glands, which undergo the characteristic inflammatory changes. Rarely the tonsils are also tumefied. Free perspiration occurs in certain patients at the commencement of convalescence.

ANATOMICAL CHARACTERS.—The opinion expressed by Virchow has been generally accepted, that inflammation of the gland-ducts occurs, with consequent œdema of the connective tissue. The œdema extends also to the connective tissue adjacent to the gland.

COMPLICATIONS; SEQUELÆ.—The swelling of the salivary glands sometimes suddenly abates, and in the male the testicles and epididymis, and in the female the mammary glands or ovaries, are involved, with sometimes more or less œdema of the labia majora. Occasionally these inflammations, which are less frequent in young children than in those nearer the age of puberty, when the sexual organs are becoming more developed, occur without subsidence of the parotid swelling. They cause considerable increase in the fever and constitutional disturbance, but with proper treatment decline in six or eight days, pursuing the same course as the parotid inflammation. Sometimes repellant applications to the neck appear to produce the metastasis, as in the following case: On March 19, 1877, I was requested to see a young gentleman of eighteen years. He had been well till March 14th, when he complained of pain below his ears, and his mother applied a towel wrung out of cold water around his neck. On the following day slight swelling was observed under the angle of the lower jaw on the right side (submaxillary and), and the cold application was continued. On the 17th the swelling ad disappeared, but the fever and headache had greatly increased, so that e was compelled to lie in bed. On the 19th, at my first visit, he had such iolent headache and was so intolerant of light and noise that I greatly feared hat he had acute encephalitis. All swelling under the ears was gone; the eft testicle was tender and beginning to swell; axillary temperature 102°. The cold cloths were removed from the neck and applied to the head, and otass. bromid., gr. xxv, administered every third hour. 20th. Axillary emperature 104°; symptoms unabated and alarming. Ordered six leeches to be applied upon the temples and left groin, and a purgative; and two drops of the tincture of aconite to be given with each dose of the bromide. 21st. Temperature 103°. States that numbness and a pricking sensation which he had felt in both legs during the last forty-eight hours had ceased (possibly from the aconite). 23d. Is convalescent; has no return of the swelling under the ears and the orchitis has abated.

Several writers mention the fact that in rare instances orchitis precedes the parotiditis. Thus, Eustace Smith mentions a case in which the orchitis preceded by sixteen hours the symptoms referable to the salivary glands. The complications alluded to which involve the sexual organs occur more frequently at puberty or in youth than in childhood.

It is said that deafness sometimes occurs during mumps, due to extension of inflammation along the Eustachian tube to the middle ear, and if the treatment proper for otitis media be employed, this form of deafness abates. Dalby mentions another form of deafness which comes on suddenly, and is supposed to be due to injury of the auditory nerve, since no appreciable lesion is observed of the auditory apparatus. The impairment of hearing in this form of deafness is likely to be permanent.

Diagnosis.—If the physician have seen but few cases of mumps, there is danger that he may mistake the swelling for an inflamed cervical gland, or *vice versâ;* but an inflamed cervical gland presents to the finger a hardness almost like that of cartilage, and it is circumscribed or round, and does not invest the ear. These characteristics contrast with the elasticity, seat, and shape of the parotid swelling, which extends forward upon the cheek and surrounds and elevates the lobule of the ear. Tumefaction resulting from diphtheritic or any other form of faucial inflammation, or from periostitis affecting the root of the posterior molar, may be detected by examining the fauces and interior of the mouth. Inflammation of the parotid sometimes occurs in debilitated states of the system, as in or after severe typhoid fever, scarlet fever, measles, etc. Occurring under such circumstances, the gland usually suppurates. The differential diagnosis between this form of parotiditis and mumps can be made by the history of the case, because mumps rarely occurs as a complication of another disease and does not cause suppuration.

Prognosis.—The result as regards life is favorable. The orchitis, if bilateral, sometimes destroys the virility of the individual. Permanent impairment of hearing may also occur as stated above.

Treatment.—This is simple. In ordinary cases it suffices to cover the swelling with oakum or carded wool. If the tenderness or pain be considerable, the gland should be covered with spongiopilin soaked in water, and gently rubbed with tincture of belladonna and glycerin in equal parts. If the patient have severe headache, with high temperature, more active measures are required, especially if delirium be also present. Saline laxatives should be given, a warm general bath or mustard foot-bath employed, and antipyrine with one of the bromides prescribed. The following prescription *will be useful for a child of ten years:*

℞. Antipyrine, ʒj;
Potas. bromidi, ʒiij. Misce.
Divid. in chart No. xv. Give one powder in a wineglassful of water every
four hours until the fever abates.

Dr. Dukes states that rise of temperature is a premonitory warnin
complication, especially of orchitis in the male, and the early applicatio
poultice diminishes its severity. If a complication occur, fomentations
be constantly applied over the inflamed part, and phenacetin or anti
given at regular intervals to reduce the fever.

SECTION III.

OTHER GENERAL DISEASES.

CHAPTER I.

INTERMITTENT FEVER.

THIS is a constitutional malady produced by a miasm which emanates
the soil. I have notes of 36 cases of this disease occurring under the
of three and a half years. Several of these patients were treated in
te practice, and the rest in institutions with which I have been con-
d. In children above the age of three and a half years intermittent
differs but little from that of the adult, while in those under this age
esents certain peculiarities. Of the 36 cases which I have observed, 19
the quotidian form, 10 the tertian, 2 the tertian becoming afterward
dian, 1 the quotidian becoming afterward tertian, while in the remain-
cases the form of the disease is not stated. In quotidian ague the
ria has been supposed to act more powerfully on the system or the sys-
is more susceptible to its influence than in the tertian form, and hence
act that the quotidian is the prevailing type of ague in tropical regions,
e vegetation is luxuriant, marshes extensive, and the heat intense.
rding to this theory, the feeble resisting power in the system of the
explains the fact that it has quotidian more frequently than tertian
nittent, although the latter is much more common in the adult in this
te.

acts demonstrate that infants sometimes receive intermittent fever from
mothers. If mothers during gestation have malarious cachexia, their
s, whether born at full time or, as often happens, prematurely, are apt
small, thin, and feeble, and occasionally they have soon after birth dis-
paroxysms of the ague. Dr. Stokes related the case of a pregnant
n with ague who believed that she noticed periodical tremors of her
s, but I suspect that she was mistaken as regards the cause, for the
ysm of intermittent in young children is not ordinarily accompanied by
ors.

he youngest infant in my practice who apparently derived the ague from
other, and probably through the fœtal circulation, had the following his-
: Its mother had occasional attacks of tertian intermittent during the
years preceding her confinement, and her baby when one week old was
ved to have the same disease, occurring also each second day, the cold-
and blueness in the first stage of the paroxysm lasting from half an
to one hour.

[illegible] ascertained whether a nursing infant may contract intermittent [illegible] but if it be admitted that it is sometimes con[illegible] through the maternal circulation, it does not seem [illegible] specific principle occasionally enters the milk as well as [illegible] frequently remarked the presence of the disease in [illegible] whose mothers were affected, and in one instance an infant at [illegible] whose mother had the ague, having contracted it in a suburban [illegible] a non-malarious part of the city, presented evident [illegible] disease. Similar observations by Frank, Burdel, and others [illegible] the communicability of intermittent fever by lac[illegible] highly probable.

[illegible] in the infant varies greatly, as in the adult. [illegible] concentrated and unusually active or the condition of [illegible] reception, the disease may commence soon after [illegible] regions travellers exposed for a single night [illegible] within twenty-four hours, but in our cooler lati[illegible] period is the rule. In the infant, however, in our [illegible] often begins in a very short time after exposure, [illegible] incubative period of some weeks. The following [illegible] relating to this point: A. M——, female, eight [illegible] days on Long Island in October, 1870, and three [illegible] the city a quotidian commenced. P. S——, male, [illegible] three days on Long Island, and a quotidian com[illegible] return. K——, nine months old, remained on [illegible] and eleven days after his return a tertian commenced. [illegible] years, remained a day and a night on Staten Island in [illegible] afterward intermittent fever commenced, preceded by a [illegible] A. I——, female, aged two years and two months, had [illegible] tertian two and a half weeks after returning from a [illegible] As there was no malaria in the portions of [illegible] infants resided, the incubative periods are nearly

[illegible] cause is believed to be a microbe which exists in the [illegible] surface. Wherever the cause exists intermittent [illegible] series of years, until the character of the soil is [illegible] specific agent is more abundant and active at [illegible] in wet than in dry seasons. It ascends from [illegible] the higher strata of the air, so that those who [illegible] ground-floor of a house are more frequently affected [illegible] the upper story. Intermittent fever is never [illegible] exhalations of a patient or through infected [illegible] It is not, therefore, contagious.

[illegible] malarial fever is not fully ascertained. The [illegible] by Prof. Salisbury in 1866, and the bacillus [illegible] Crudeli in the soil of malarial regions, which [illegible] of the malarial fevers, are now believed to be [illegible] these diseases.

[illegible] the organisms discovered in the malarial blood [illegible] occur in the red blood-corpuscles and are also free [illegible] size is about one-third that of the red blood-[illegible] and others larger than this. Some of them [illegible] and others are without pigment. In fresh blood [illegible] movements, changing their forms like the white [illegible] are living organisms we infer from their move[illegible] found nowhere except in the blood of malarial patients, and chiefly during the paroxysms. Marchiafava and Celli state that they have produced malarial fever in a person previously healthy by injecting blood containing these organisms into a vein; and they found the same organisms in his blood after the fever had appeared. They believe that these bodies are parasites having amœboid movements, and that they penetrate the red blood-corpuscles, which they destroy in proportion to the degree of encroachment, and produce in them the characteristic malarial pigment. Osler also describes at length the various forms which this organism assumes, the crescentic form appearing especially in chronic cases. He states that quinine is a specific against these organisms, causing them to disappear (*Brit. Med. Jour.*, 1887). Councilman of Baltimore examined this organism, and noticed its highly polymorphic nature, presenting globular, crescentic, rosette, and flagellate forms. He states that the administration of fifteen grains of quinine daily for three or four days causes the almost total disappearance of the organism. But the crescentic organism of malarial cachexia is not materially affected by the quinine (*Therapeutic Gaz.*, 1887). Subsequent investigations have therefore tended to substantiate the opinion of Laveran, that malaria is caused by an organism having amœboid movements which penetrates and destroys the red blood-corpuscles.

Whatever may be the nature of the malarial poison, it often clings tenaciously to the system, and is probably reproduced in it even under circumstances favorable for its elimination. Thus, at one of my cliniques at Bellevue Hospital Medical College in 1871, a child ten years old was presented who had had every year for seven years attacks of intermittent fever. The disease was contracted at the age of three years in Harlem, and the subsequent residence of the family had been in a part of the city where there was no malaria.

SYMPTOMS.—In infancy, and especially prior to the age of eighteen months, the symptoms differ in certain respects from those which characterize the malady in the adult, and are universally known. In childhood the symptoms are similar to those in the adult, and need not therefore be described in this connection.

In the infant the type, as we have seen, is quotidian, with now and then a tertian. Advancing beyond the age of eighteen months, we meet more and more cases of the tertian type, and in childhood the tertian is the common form. I have known the quotidian in the infant, when cured, to reappear a few weeks later as a tertian; but ordinarily it remains quotidian, unless the patient have reached the age at which the tertian type predominates.

The paroxysm in the young infant presents three stages, as in the adult, but while the second, or febrile, is well marked, the first and third are much less pronounced. The patient does not shake (exceptionally one does even within the first year) in the first stage, but a slight tremor may or may not be observed. The countenance presents a sunken appearance, the lips and fingers are livid, while portions of the surface not livid are pallid, with the goose-flesh appearance, which is, however, less marked than in children of a more advanced age. The blood leaves the surface, which consequently shrinks, while it accumulates in the veins and internal organs; the pulse is feeble and readily compressed; the surface grows cool from the diminished supply of blood, but the breath is warm, and the internal temperature, so far from being reduced, is elevated two or three degrees. The parents may be alarmed at the sudden sinking of the vital powers and seek medical advice, but in other instances the first stage is so slight that it passes unperceived till they have been taught to watch for it, and the second stage first attracts attention.

In the second or febrile stage, which immediately succeeds, the pulse becomes full and rapid, 120 to 130 or 140 beats per minute, and the external as well as internal temperature is elevated as in few other diseases (104°–108°). The face is flushed, surface dry, and head painful, as evinced by the features. This stage lasts about two or three to six or eight hours. The third stage, or that of perspiration, succeeds, which terminates the suffering of the patient till the following paroxysm. In infancy the perspiration is not abundant, and in the first half of this period is nearly absent. In the interval of the paroxysm the patient appears well, except a degree of languor.

In 24 of the cases of infantile intermittent which I have treated my notes describe the character of the paroxysms. In 16 of these there was no chill or trembling in the first stage, but blueness and coolness of the extremities and features and sudden prostration. This stage lasted from ten minutes to one hour. In the 8 remaining cases the infants were observed to tremble or shake as in adult cases. The perspiration of the third stage was in nearly all cases, when observed, slight and of short duration, but in some it was not observed.

During the cold stage passive congestion of the internal organs occurs to a greater or less extent, but the circulation is equalized during the reaction of the second stage. The spleen, whose capsule is distensible, soon enlarges in many patients in consequence of the frequent and great congestions, constituting the "ague cake." This enlargement is more common in children than adults. Since my attention has been particularly directed to this subject, I have been able to feel the enlarged spleen, by examination through the abdominal walls, in probably one-third of the cases under the age of ten years. This organ returns to the normal size after the ague is cured. From the intimate relation of the spleen to the composition of the blood, it is evident that the character of this fluid must be affected if intermittent fever be protracted. The blood becomes more and more impoverished and a state of decided hydræmia supervenes. A few weeks' continuance of the ague suffices to produce decided pallor of the features and surface generally, and as all watery blood is prone to transudation, such patients not infrequently present more or less œdema of the face, ankles, and other parts. Sometimes also, especially under unfavorable hygienic circumstances, purpuric spots (purpura hæmorrhagica) appear under the skin, affording additional proof of the change which the blood has undergone.

In long-continued cases of malarial disease in the adult waxy degeneration of organs is apt to occur, as well as melanæmia. Pigment-cells, flakes, and particles appear in the blood, the coats of the minute arteries, and in various organs, as spleen, liver, etc. In the child these results are more rare.

Intermittent fever in children, if proper remedial measures are employed at an early period, is ordinarily not dangerous, and is quite amenable to treatment; but that comparatively infrequent and fatal form of it designated the pernicious occurs more frequently in children than adults. In New York City, where the type of malarial diseases is mild, I have never met a case of pernicious intermittent in the adult, but I can recall to mind such cases in children, two of them fatal. This form of the fever occurs in a smaller proportionate number of cases in infancy than in childhood, probably because the cold stage is less pronounced. In the pernicious ague the system is overpowered—it does not react in a degree commensurate with the intensity of the disease. The patient enters the cold stage, becomes stupid, and, if not relieved by prompt and efficient measures, passes into fatal coma. A type of the disease, therefore, which would not be pernicious in a robust individual may be such in one of a broken-down constitution and feeble

ower. In most cases occurring in children the coma is preceded
sia, which is apt to be general and protracted.

psia increases the passive congestion of the cerebro-spinal axis
esent in this stage, and if not speedily relieved may end in trans-
f serum over the surface of the brain, and perhaps meningeal
causing fatal coma. This has occurred twice in my practice.

mes in young children the diagnosis of intermittent fever is doubt-
because the disease has not continued sufficiently long or there
en the characteristic paroxysm. The patient may be feverish and
th anorexia and evidences of headache, but without the usual dis-
mptoms. I have sometimes in such cases been able to establish
sis by detecting enlargement of the spleen. In examining for the
e" the child must lie quietly on its back, and the fingers, placed
tween the epigastrium and umbilicus, be carried gently but with
re outward in the direction of the spleen, when the anterior edge
gan will be felt if it be enlarged. It is impossible to make the
n when the child cries, on account of the contraction of the
muscles.

MENT.—It is evident that no time should be lost in applying appro-
edies in a case of infantile ague, for, although the first paroxysm
ild, the next may be more severe and attended with danger.
the sooner the disease is cured the less liable it seems to be
Therefore we prescribe at once the sulphate of quinia or cin-
e and a half grains of the latter producing the effect of about
of the former. Our experience in the children's class in the Out-
rtment has been chiefly with the sulphate of cinchona on account
apness, and there has yet been no case of ague which it has failed
A recent writer has published statistics showing his success in
ermittent fever by this agent, but nothing in therapeutics is more
to cure this disease in our climate by either of the sulphates men-
he chief difficulty consists in preventing a return. To an infant
ars I prescribe one grain of sulphate of quinia or the equivalent of
of cinchona three times daily, till all symptoms of the ague have
d; then twice a day during the subsequent week, and afterward
for some days, and finally twice or thrice a week. It is only by
cted use of the drug in occasional doses that the return of the
nt can be prevented.

important in administering these sulphates to infants to employ a
ich will, so far as possible, disguise the bitterness. The vehicle
prefer for their administration is the elixir adjuvans, elixir tarax.
better still, the syrupus yerbæ santæ comp. The following formula
ild of three years:

℞. Quiniæ sulphat., gr. xvj;
Syr. pruni virginiani,
Syr. yerbæ santæ comp., āā. ℥j. Misce.

ving is also a good formula:

℞. Quiniæ sulphat., gr. xvj;
Syr. yerbæ santæ comp., ℥ij. Misce.

oonful three to five times daily. The first dose should be given
ly after the fever abates. In this climate two or three days suffice
he disease, after which, by daily but gradually diminished use of
n the manner stated above, the return of the malady is prevented.

Protracted cases attended by anæmia require the use of iron in addition to the remedy which is designed to control the disease.

For children with irritable stomachs, who cannot retain the salts of quinine which are ordinarily prescribed, the tannate may be employed in powder or lozenges with chocolate; but in order to produce the same effect the dose must be two and a half times greater than that of the sulphate or muriate. The protracted cachexia which follows an attack of malarial fever is best treated in children, as it is in adults, by arsenic, especially the liquor potassæ arsenit, and iron. Quinine is much less efficient in curing this cachexia than these agents.

CHAPTER II.

REMITTENT FEVER.

If a physician were to consult the standard treatises on diseases of children in order to ascertain the nature of remittent fever, he would rise from the perusal with no clear idea of it. One tells us that the remittent fever of children is identical with typhoid fever of adults; another, that it is a gastro-intestinal inflammation; and, finally, Hillier believes that there is properly no such disease, and that the term should be dropped from the nosology of diseases of children. There is, however, a remittent fever of children as well as adults, and much of the confusion which exists in reference to it arises from the fact that writers have not kept in view what constitutes a fever.

Febrile action which has a local cause is not an essential fever, and should not be described as such. It happens that in children a symptomatic remittent fever arises from a variety of local causes, as dentition, intestinal worms, subacute gastro-intestinal inflammation, etc. But all such cases should be excluded from our consideration of remittent fever as clearly as we distinguish the continued fever of pneumonia or bronchitis from that of typhus or typhoid.

There is an essential remittent fever of children due to malaria. The same conditions which produce intermittent fever do, in a certain proportion of cases, produce a fever which does not intermit, but continues with more or less pronounced exacerbations a certain number of days, when it ceases or becomes intermittent. Those who practise in malarious localities notice a larger proportion of cases of remittent fever among children than adults, because their constitutions are less able to resist the malarial poison, so that an exposure which in an adult would produce milder disease—to wit, a tertian ague—frequently causes a quotidian or remittent in the child.

In hot countries, where the malarial poison is more active and the diseases due to malaria more severe than in the temperate regions, cases of remittent fever due to the marsh miasm are more common than in the temperate regions. The "jungle fever" of India is a malarial remittent fever of a severe type.

In my opinion, the term "remittent fever," if retained in nosology, should be restricted to those fevers of a remitting type which are due to marsh miasm, so that it differs from intermittent fever in the fact of a greater intensity and not in its essential nature. The one disease is characterized by intervals of apyrexia, and the other by periods of a diminution, [illegible] not cessation, of the febrile symptoms.

New York City, and probably in other localities in the temperate zone, tinued fever of a mild type not infrequently occurs in children, espe- in the spring and autumn, running a course of one to two, three, or four, weeks, with in many cases a slight increase in the latter part of ay. Children with this fever are languid, moderately thirsty, and with- ppetite. They complain in the first days of headache. Their tongue is rately furred. They have a slight cough, no diarrhœa, a temperature of or 102°, and many of them do not feel ill enough to go to bed, except e usual hours of sleep, during the whole progress of the disease, which nues a variable time, from one to three weeks. This disease physicians ew York sometimes designate remittent, sometimes malarial, and occa- lly, the severe cases, typho-malarial. I have noticed that this light a of fever occasionally occurs in a household or asylum in connection a typical cases of typhoid fever, and therefore am led to regard it as a d form of this disease. Thus in a family in West Fifty-fourth street two dren had this fever so mildly that they were every day dressed and sitting etly in the room, but their aunt, a lady of about thirty years, who took e of them, sickened with a severe typical and protracted typhoid fever ile she was attending them. In the Roman Catholic Orphan Asylum of s city typhoid fever occurred some years ago, and some of the cases were the mild form described above, but two or three were fatal, and the cha- cteristic lesions of typhoid fever were discovered at the autopsies. There- re this mild continued fever, having perhaps a slight but scarcely apprecia- le morning remission, should not, in my opinion, be designated remittent, malarial, or typho-malarial—terms which have been applied to it—but be regarded as a mild typhoid fever. It seems to me that typhoid fever, like diphtheria, does sometimes present so mild a type in childhood that the patients are not confined to bed, and their sickness terminates in one or two weeks, instead of three or four, as stated in the books.

Symptoms.—This disease begins with chilliness and headache, and exacerbations and remissions occur each day. In severe cases the temperature during certain hours reaches 104° or 105°, and the exacerbation may be accompanied by delirium or stupor. The severe headache, restlessness, and jactitation show that the nervous system is profoundly involved in certain cases. There may be distinct remissions in the beginning, and afterward, for a few days, the fever be pretty uniform, when it again remits or ceases. The tongue is covered with a light fur. Thirst, loss of appetite, a tendency to constipation, and scanty, high-colored urine containing urates, are common symptoms.

Diagnosis; Prognosis.—Typhoid fever usually comes on more gradually than remittent fever, and is not attended by so great a daily variation in temperature. It is of more importance to make the differential diagnosis between remittent fever and the acute local diseases, especially meningitis and pneumonitis; but a careful examination of the signs and symptoms, which will be considered hereafter in our remarks on the local diseases, will enable us to make the diagnosis. The prognosis is favorable with prompt and appropriate treatment.

Treatment.—Prompt treatment by one of the salts of quinine is required. Formerly it was thought advisable to employ first laxative and diaphoretic remedies, in the belief that quinine, if administered immediately, might cause cerebral congestion. But since the bromides and antipyrine came into use no treatment preparatory to the use of quinine is required, unless a single laxative dose in the beginning, as by calomel or the magnesium citrate. Alternate doses of quinine and bromide of potassium, at intervals of two *hours, will in a few days* control the fever. The bromide will prevent any ill effects of the quinine in producing cerebral congestion, which was formerly feared. In cases attended by marked pyrexia, jactitation, and delirium antipyrine should be added to the bromide.

CHAPTER III.

TYPHOID FEVER.

Typhus and typhoid fevers occur in children, but the former is mild and infrequent, rarely occurring except when adults of the same household are affected. It requires little treatment besides good nursing. Typhoid fever, on the other hand, is not infrequent in children, and, as it presents certain peculiarities prior to the age of puberty, it is proper to describe it in this connection. This disease is much less common in infancy than in childhood, and in the first half of infancy is believed to be rare. Still, there can be no doubt that many cases in the first years of life are not diagnosticated, being mistaken for subacute and protracted entero-colitis. It is probably more common under the age of six years than is usually supposed, although the younger the child below this age the less frequent does it appear to be, while above the age of six years it is more and more frequent until puberty. In the statistics of Cadet de Gassicourt, embracing 276 children, 3 were at the age of two years, 7 at the age of three years, 8 at four years, 13 at five years, and the number gradually increased in successive years until there were 32, 41, and 42 cases at the ages of twelve, thirteen, and fourteen years. Farnham has reported a case occurring in a girl of three years whose father was at the time convalescing from the fever. She complained of feeling tired, and was listless, but fretful. Her surface was hot and face flushed in the latter part of the day. Her temperature on the seventh day reached 104.8°, when she was put to bed. The fever ceased on the sixteenth day, after which the temperature was subnormal for ten days.

Causation.—Klebs in 1881 announced that he had discovered a bacillus in cases of typhoid fever, which he believed to be the cause of the disease, and which he designated the bacillus typhosus. Each bacillus contained a spore in its interior, and often one at its extremity from which new bacilli developed.[1] About the same time Eberth also discovered the bacillus in the intestinal mucous membrane, the mesenteric glands, and spleen in typhoid fever, and ascertained that it differed from other bacteria in the staining. In 17 cases these bacilli were found in 6, and not found in 11.[2]

Gaffby announced the results of his observations and experiments with the bacillus typhosus. He succeeded in cultivating it in various substances. Upon the surface of potato, sterilized by steam, it grows abundantly, forming rods 0.2μ thick and 0.6μ to 0.8μ in length. The rods have active movement and are aërobic.

The bacillus typhosus is constantly found at an early stage of typhoid fever in the spleen, mesenteric glands, Peyer's patches, and the solitary follicles. Occasionally it has been discovered in the lungs, liver, and kidneys, and rarely in the blood. When the symptoms pertaining to the fever begin to abate, the bacillus also begins to disappear, so that in the fourth week it sometimes cannot be discovered, and is usually less abundant than in the first and second weeks; but it may be present after the fourth week. The bacilli n colonies or irregular masses. The figure represents the bacilli as ed in the spleen.

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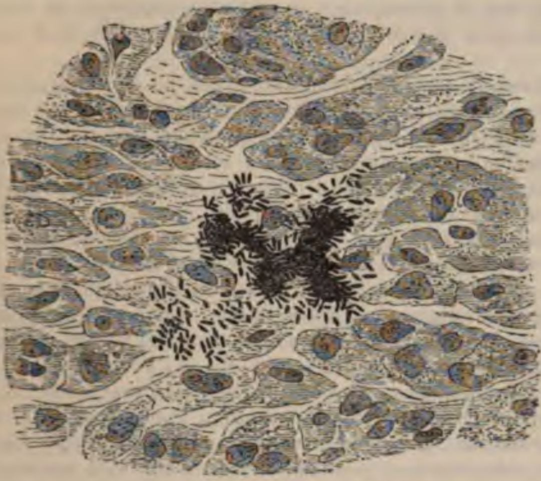
[1] *Phila. Med. Times*, Dec. 3, 1881.

[2] Brit. Med. Jour., Nov. 26, 1881.

e bacillus typhosus has not been discovered in any other disease than id fever, although search has been made for it. Fränkel and Sim-s inoculated rabbits with it. They were sick in consequence, and in those that died the spleen, the solitary follicles, Peyerian patches, and certain lymphatic glands were found tumefied. For the reasons stated, pathologists for the most part agree that this bacillus is the cause of typhoid fever, but from the fact that no bacilli, or but few, are found in the blood, it is not improbable that the fever and other prominent symptoms of the disease may be largely due to ptomaïnes which the bacilli produce.

FIG. 29.



The bacillus typhosus is very tenacious of life. Prudden found that it could be cultivated after it had been frozen in ice one hundred and three days; also after it had been subjected to a heat of 132.8°, and again when it had been alternately frozen and thawed.[1] Vidal and Chantemesse, by capillary punctures of the spleen during the life of the patient, obtained the bacillus, with which they inoculated mice and guinea-pigs, and subsequently discovered this organism in their lungs and abdominal organs. They also found it in the placenta of a typhoid patient who aborted at the fourth month.[2]

Vaughan and Novy obtained cultures of the typhoid bacillus from the water used by a considerable number of typhoid-fever patients, and the syrupy extract containing the bacillus and the ptomaïnes produced by it, injected under the skin of cats, caused 2° to 4.5° of rise in temperature. They have formulated the following definition of the disease: "An infectious disease arises when a specific pathogenic micro-organism, having gained admittance to the body, and having found the conditions favorable, grows and multiplies, and in so doing elaborates a chemical poison which induces its characteristic effects."[3]

The discovery of the bacillus typhosus, and of its causal relation t typhoid fever, affords important aid to our knowledge of the manner i which typhoid fever is produced. The theory advocated by Murchiso that this disease may originate *de novo* by exposure to filthy accumulations of any kind, is now known to be false. Only such substances can communicate the disease as contain the specific bacillus, and it is obviously necessary that this bacillus should in some manner enter the system, so as to infect the individual. Exhalations from the most fifthy accumulations, and even inoculation with the most fetid material, will not cause typhoid fever unless the bacillus typhosus be present. But the remarkable vitality of this organism, and its power of propagation in certain substances in common use, as water and milk, give rise to epidemics in localities where it happens to be introduced.

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[1] *N. Y. Med. Rec.*, 1887.

[2] *Lond. Lanc.*, 1887.

[3] *Ptomaïnes and Leucomaïnes*, 1888.

Typhoid fever is seldom, and perhaps not at all, contracted by inhaling the breath of a patient or exhalations from his surface, but his urinary and fecal excreta contain the bacillus in abundance and are the most common source of infection. Many instances are on record of epidemics caused by the use of water for culinary or drinking purposes which had been in some manner polluted by the excreta of typhoid patients. One of the earliest recorded instances of this kind was observed by the late Prof. Austin Flint, in 1843. In a village in Western New York a traveller with typhoid fever was cared for at the inn, and his excreta were deposited near the well which supplied the whole village except one family. The stranger died, and within a month typhoid fever occurred in all the families of the village except the one that obtained water from a different well. At Pierrefonds 23 persons occupied adjacent houses. The water which they used was obtained from shallow wells into which it had percolated through a porous soil from a neighboring stream. This stream received the drainage of two cesspools, one being thirty and the other sixty-five feet from the well, and the well was on lower ground than the cesspools. In August and September, 20 of the 23 persons were attacked with typhoid fever, and in one of the houses 4 died. The water supplying this house was examined by Chantemesse in October, and was found to contain the bacillus of typhoid fever in abundance. A month subsequently none could be found. Vienna, Angoulême, Cincinnati, and Bordeaux may be mentioned among the places where the occurrence of typhoid fever has been traced to pollution of the drinking water. In 1888 a severe epidemic of typhoid fever occurred at Iron Mountain, Michigan, and in the drinking water employed in families that had suffered from the disease Vaughan and Novy found the typhoid bacillus. Therefore, sufficient observations have been made to show that many epidemics of typhoid fever have been caused, and are still caused, by the use of polluted drinking water which contained the specific bacillus, and that when epidemics arise from this cause it apparently gains admittance into the system through the digestive apparatus. In 1871, Ballard, health officer of Islington, called attention to the fact that the use of infected milk sometimes causes typhoid fever. He had investigated an outbreak of the disease which was apparently produced by rinsing milk-cans with water which was polluted by direct communication of the tank with drains. Since then a considerable number of epidemics have been traced to the use of infected milk. The milk in most of the investigated cases was contaminated by polluted water employed in rinsing the cans or added to the milk for the purpose of diluting it. Milk may also receive the typhoid bacillus from ice which contains this organism and is employed for the purpose of reducing the temperature or for dilution. Seitz, Wolfhügel, and Reidel have shown that the typhoid bacillus grows freely in milk. Vaughan mixed water containing the typhoid bacillus with milk, and subsequently was able to obtain from the milk a poisonous extract due to the growth and activity of the bacillus (*Med. News*, Jan. 28, 1888). Therefore the milk-supply should also be investigated on the occurrence of an epidemic.

at typhoid fever is probably communicated by the inhalation of air
contains the typhoid bacillus, although, as we have seen, the disease is
kely to be contracted by the attendants of typhoid patients if there be
pt and efficient disinfection of the excreta. In New York City many
vations show that the filthy flowing streams in the sewers are infected
the typhoid bacillus, and cases occur in which the fever seems to be
the escape of the sewer gas into the houses. Thus, in my practice,
ouse whose plumbing was supposed to be faultless three children who,
as known, had not been exposed outside, sickened with typhoid fever.
rough examination finally revealed the escape of sewer gas into the cel-
a strong current. The inference is that in such instances the tainted
nveys the bacillus to the lungs, and this organism enters the system
gh this organ. But it is true that the bacillus in such instances may be
ted from the air in the food or drink, or in the mouth or fauces, and be
wed, so that the systemic infection may occur through the digestive
n. But it suffices, so far as the employment of preventive measures is
rned, to know that an atmosphere infected by exhalations from filthy
es may communicate typhoid fever without the actual presence of a
id patient. Between 1873 and 1885, one hundred and forty-six cases of
oid fever occurred in one of two barracks occupied by the German artil-
while cases did not occur in the other barrack, although the water and
used in the two were the same. Finally, suspicion fell upon the bed-
and clothing, and the discovery was made that recent patients had worn
clothes of men previously attacked, and even stains of dried fecal
er were found in their pants. Saturation of the infected articles and
barrack with chlorine gas followed by dry heat was now employed, and
ore cases occurred (*Med. Press and Circ.*, March 28, 1888). There-
the typhoid bacillus gains admittance into the system not only by the
f infected drinking water, milk, and solid food, but also by the inhala-
of an infected atmosphere.

NATOMICAL CHARACTERS.—Since typhoid fever is a constitutional dis-
we would expect to find early and important changes in the blood. No
tion, however, has been discovered in this fluid peculiar to typhoid
. The amount of fibrin is diminished, as in most of the essential fevers,
ts coagulation is feeble, forming, when the blood stands, soft, small, and
clots. When the fever has continued for some time a state of anæmia
or less decided supervenes in which the amount of albumen and blood-
scles is diminished. Although there are often decided symptoms refer-
to the nervous system, no constant changes have been discovered in the
or spinal cord. The changes observed in them when death has occurred
course of typhoid fever have been for the most part due to other
s. It is different with the respiratory system. After the first week of
id fever mild bronchitis is almost as constant as inflammation of the
s in scarlet fever, and accordingly we find in fatal cases redness and
ening of the bronchial mucous membrane, which is covered with a viscid
rdinarily scanty secretion. Hypostatic congestion of the lungs, with
or less œdema, and in severe and enfeebled cases hypostatic pneumo-
re not uncommon. In the bronchitis and state of feebleness we have
auses of pulmonary collapse, and this lesion is not infrequent over
d portions of the lungs, especially if the bronchitis affect the smaller

e lesions occurring in the digestive system are important. The pharynx
mal or slightly affected. The mucous membrane of the œsophagus
omach is sometimes normal or nearly so, and in other cases hyperæmic.
aid that ulcers have been occasionally observed in the cardiac end of

the œsophagus. The mucous membrane of the small intestine is more or less injected, and at an early period, even by the second or third day, the patches of Peyer, solitary glands, and at the same time the mesenteric, begin to enlarge. I have made microscopic examination of these glands in typhoid fever of the adult, and have found a considerable increase of the small round granular cells of which they are composed. It appears, therefore, that the enlargement is due mainly to hyperplasia of the cellular elements of the glands, though there is probably infiltration to a certain extent of inflammatory products between the cells. The mucous membrane over the glands undergoes inflammatory thickening and softening. In the adult sloughing of this membrane is frequent, with the disintegration of the glands and their elimination into the intestines, producing ulcers, small and circular, corresponding with the site of the solitary glands, large and oval or irregular, corresponding with the site of Peyer's patches. Disintegration of these glands and the formation of ulcers are less frequent in children than in adults. In the adult who recovers the mesenteric glands and the solitary and agminate which are not destroyed return to their normal state by fatty degeneration, liquefaction, and absorption of the redundant cells. In the child this is the common result, instead of sloughing and disintegration, as regards both the solitary and agminate glands, and uniform result as regards the mesenteric, and I may add bronchial glands, which are also in a state of hyperplasia. The absence of ulceration or its slight extent affords explanation of the fact that intestinal perforation is very rare in children. The inflammatory changes described above pertain chiefly to the ileum. The duodenum and jejunum present their normal appearance or are moderately hyperæmic in places and their follicles swollen.

The spleen gradually enlarges, often to twice the normal size, has a dark-red color, and is softened. Enlargement of the spleen possesses great diagnostic value in those cases in which the diagnosis is obscure. For while very similar intestinal lesions may occur in chronic entero-colitis, the coexistence of these lesions with the splenic enlargement and softening shows the constitutional nature of the malady. The liver usually presents its normal appearance, or it may be pale in consequence of the anæmia, or, on the other hand, it may be hyperæmic. Microscopic examination sometimes reveals a granular state of the hepatic cells with indistinct nuclei.

In cases which are severe and which present a decidedly adynamic type the muscles become soft and flabby, the action of the heart is feeble, and more or less passive congestion of the viscera results. In such cases congestion of the kidneys and albuminuria are not infrequent. Parenchymatous degeneration of the kidneys occasionally occurs, the epithelium becoming granular, the cells indistinct, and their nuclei invisible. Liebermeister states that he has frequently noted the absence of albuminuria during the fever when the autopsy showed marked degenerative changes in the kidneys. Inflammation of the endocardium and pericardium is rare, but the myocardium exhibits structural changes in severe cases. Atrophy and fatty degeneration of its muscular fibres sometimes occur, which may lead to the formation of clots in the cavities of the heart, and consequent emboli in other organs. Hoffmann demonstrated the occurrence of fatty degeneration of the minute arteries in various organs in prolonged cases of typhoid fever, and degenerative changes have also been observed in the voluntary muscles.

PATHOLOGY.—Recent investigations relating to the acute infectious diseases of childhood render it probable that as regards most, if not all, of them systemic infection occurs through ptomaïnes or poisonous chemical agents which are produced by the action of the microbes which are the specific principles. This is believed to be true as regards typhoid fever. In 1885, Brieger obtained a ptomaïne from cultures of the typhoid bacillus which, inoculated in guinea-pigs, caused salivation, hurried breathing, dilated pupils, diarrhœa, paralysis, and death within one to two days.[1] From such observations and experiments the theory has arisen that the symptoms which characterize typhoid fever are mainly due, not directly to the action of the bacillus, but to a ptomaïne or ptomaïnes created by the bacillus and absorbed into the system. This theory also receives support from the observations and experiments of Hoffa, Sirotirvin, Beaumer and Peiper, and others.

Incubative Period.—As in scarlet fever and diphtheria, the incubative period in typhoid fever varies. In three cases detailed by Griesinger the fever began twenty-four hours after exposure. In a school at Clapham, 20 out of 22 boys sickened, according to Murchison, within four days after exposure. Authenticated cases of a longer incubative period are on record, so that Murchison believed that it is commonly about two weeks, and William Budd that it is in most instances from ten to fourteen days, but cases have occurred in which it seemed to be as long as twenty-eight days.[2]

Symptoms.—Typhoid fever has a prodromic stage of a few days, sometimes of a week or more, in which the child appears languid, indisposed to play, and has little appetite, but complains of no pain unless occasional slight headache, and has no symptoms which would lead the friends, or even physicians, to suspect the nature of the disease which impends. By and by a slight fever occurs.

In exceptional instances typhoid fever begins with a chill, followed by pronounced fever. It occurred in 3 of the 14 cases observed by Dr. Jacobi in Bellevue Hospital. This was a larger proportion of cases with such commencement than I observed in the epidemic of 1882 or have since observed, but the cases in Bellevue seem to have been unusually severe, since 5 of the 14 died.

The fever, which gradually becomes more pronounced, remits, but does not cease in the morning, and it has evening exacerbations. After the first week of fever the remissions are less marked, but the fever is not uniform at any period in its course. Hence some of the writers on diseases of children continue to designate typhoid fever of children remittent fever, fully aware of its identity with typhoid fever of the adult. As the case advances the appetite fails, all solid food being refused, and liquid food being taken more from thirst than hunger. The tongue in the first week, and in some patients throughout the course of the disease, is covered with a light moist fur, while in others having a graver type of the fever the tongue after the first week is dry and brown. During the prodromic period and in the first week the bowels act regularly or are slightly relaxed, and they are readily affected by purgative medicines. After the first week there is in some children a tendency to diarrhœa, which requires now and then the use of astringents, the stools being watery and brown or dark yellow. Diarrhœa is less frequent in children than in adults, and in some children it does not occur during the entire sickness. The abdominal walls are seldom retracted, but prominent, especially after the first week, in consequence of meteorism, which is present in children as well as adults. Sometimes there is apparent tenderness when pressure is made over the right iliac region, but this must not be confounded with hyperæsthesia, which is common in the commencement of febrile diseases in children, and which is observed especially upon the abdomen, chest, and inner part of the thighs.

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[1] L. Brieger, *Ueber Ptomaïne*, Berlin, 1885–86.

[2] See article "Typhoid Fever," *American System of Practical Medicine;* Philada., 1885, Lea Bros.

The respiration in the first week is slightly accelerated, as it is in all febrile diseases. In the second week, and subsequently when bronchitis is developed, the respiration is ordinarily more accelerated, though not in a marked degree, unless in those exceptional instances in which there is an abundant collection of mucus in the smaller bronchial tubes. A cough is often present, dependent on the bronchitis, and varying in character according to the degree and stage of the inflammation. In the first days of the fever it is infrequent or lacking; at a later stage it is more frequent and not so dry, though in cases of ordinary severity the amount of expectoration is inconsiderable. Hypostatic congestion, œdema, hypostatic pneumonia, splenization or thickening of the alveolar walls, and collapse, which not infrequently occur in the advanced disease, increase more or less the frequency of the respiration and the cough and modify the physical signs.

The pulse in the first week, in ordinary cases, is from 100 to 110 or 115. It gradually becomes more accelerated, numbering in the second week 123 or more; in grave cases even 160. The more frequent the pulse, the greater the danger and more unfavorable the prognosis. During the exacerbations the number of pulsations per minute is fifteen or twenty more than in the remissions. The change in temperature corresponds with that of the pulse, being from 1° to 2° higher in the exacerbation than remission. The extremes of temperature in cases of ordinary severity are about 101° to 104°. A temperature above 105° shows a grave, perhaps a fatal, type of the disease or else a serious complication.

There is great variation as regards the symptoms referable to the nervous system. Headache is common in the prodromic and initial stages, after which it ceases. A few are delirious even from an early period, screaming loudly or muttering incoherently, but the majority are quiet, having, indeed, a degree of mental dulness, but being able to appreciate questions when aroused and answering correctly. Subsultus tendinum and carphologia, which some exhibit, show that there is profound disturbance of the nervous system. Epistaxis occurs occasionally in the first week, as in the adult, but is usually slight.

The rose-colored eruption appears in children as well as adults between the sixth and twelfth days, but is more frequently absent in the former than the latter; sometimes the number of spots is less than half a dozen. Sudamina are common in the second and third weeks, and perspirations may occur at any time in the course of the fever, but without amelioration of symptoms. More or less deafness is common, being in most instances a purely nervous symptom, without, therefore, any structural change in the ear, but it is possible, as has been suggested by certain writers, that it sometimes results from inflammatory thickening of the Eustachian tube or external meatus, or from a weakened and flabby state of the muscles of the ear.

DURATION.—As in diphtheria, so in typhoid fever, the duration varies greatly in different cases. Mild forms of the disease terminate within one week, but cases of a severe type may continue several weeks. Henoch states that the duration of 80 cases which he observed were as follows: from seven to ten days, 11; from ten to fifteen days, 26; from fifteen to twenty days, 16; from twenty to thirty days, 21; and from thirty to forty-nine days, 6 cases. The limits in the duration were therefore seven days in the shortest and mildest cases, and forty-nine days in those that were the most protracted. In the cases of short duration the diagnosis was rendered clear by the roseola, enlargement of the spleen, and diarrhœa. When the disease begins to abate, there is frequently in the morning a complete apyrexia and a return of the fever in the latter part of the day. This period of an intermittent fever usually varies from two to five days. Forchheimer, who observed a severe epidemic of typhoid fever in Cincinnati, says that this disease in children sometimes terminates in six days (*Columbus Med. Jour.*, 1888). In a discussion relating to typhoid fever at a recent session of the New York Medical Association, Dr. E. G. Janeway also stated that this disease sometimes terminates within ten days. In cases continuing three or four weeks the patient becomes progressively more emaciated and feeble, and in a severe form of the disease his condition seems very unpromising to one not familiar with the clinical history of the fever. Pale, emaciated, and feeble, probably passing his evacuations in bed, and taking little notice of objects around him, he presents at the close of the third week or in the fourth an appearance of helplessness, notwithstanding the best nursing and the constant employment of sustaining measures, which is truly discouraging.

Relapses—Second Attacks.—Rilliet and Barthez called attention to the fact that relapses sometimes occur, although they observed only 3 such cases in 111 patients. Henoch witnessed 21 relapses in 137 cases, the relapses occurring after severe and after mild cases. The majority of the cases in which relapse occurred were, however, mild. As a rule, the relapse occurred between the third and fifth weeks, and after a complete apyrexia of three to ten days. In one case even eighteen days of apyrexia had occurred when the fever was renewed. In some cases the relapse took place during the decline of the fever, when there was a morning intermission and an evening fever, the fever again becoming continuous. Eichhorst, in examining the records of 666 cases occurring in Zurich, ascertained that second attacks occurred in 28 persons, or in 4.2 per cent. of the cases. He has observed cases of a third and even of a fourth attack, so that, as in diphtheria, a first or even a second attack does not destroy the susceptibility to the disease.

COMPLICATIONS.—The chief complications of typhoid fever are broncho-pneumonia, already sufficiently described, enteritis, intestinal hemorrhage, peritonitis, otitis, parotiditis, and muguet. In one instance I lost a patient about ten years old, in whom the fever had nearly terminated, by the sudden accession of croup. There is, as we have seen, in ordinary cases more or less inflammation of the mucous membrane of the air-passages and of the intestines, especially in the vicinity of the patches of Peyer. It is easy to understand how, under circumstances which may arise in the fever favorable to the development of mucous inflammations, the bronchitis and enteritis may so increase as to constitute complications. They are the most frequent of the serious complications.

Feeble action of the heart, common in severe cases of typhoid fever, and which after the second week is partly attributable to granulo-fatty degeneration of the muscular fibres of the heart, which is frequent in grave forms of the infectious diseases, obviously favors the occurrence of bronchial and pulmonary congestion. Hence the proneness in these cases of the inflammation to extend downward from the larger to the smaller bronchial tubes and to the lungs, so that broncho-pneumonia becomes an occasional very grave complication.

In the child as well as adult with this disease the mucous membrane of the lower part of the ileum in the vicinity of Peyer's patches is frequently thickened and hyperæmic—a true intestinal catarrh. We can readily understand how under certain circumstances this may become aggravated so as to constitute an intestinal inflammation of considerable extent and gravity, a severe entero-colitis, so that the local symptoms predominate over the constitutional and aggravate the latter.

In the adult, as is well known, the Peyerian and solitary glands, becoming more and more prominent by proliferation of the cellular elements (the lymphoid cells), begin to ulcerate in the second week, and slough in the third, forming the typhoid ulcer, which is slow in healing and aids in keeping up the diarrhœal state. Such destructive or necrotic inflammation is rare in young children, but it may occur in those of a more advanced age.

Intestinal hemorrhage is therefore an occasional accident. Hillier met 4 cases in 30 of the fever. It indicates the presence of ulcers upon the surface of the intestines. The younger the child the less the liability to it. Some in whom it has occurred recover, but others die. A girl of nine years complained of severe abdominal pain on the seventeenth day of the fever, which was followed by syncope and death. At the autopsy one of Peyer's patches was found deeply ulcerated, and at the bottom of the ulcer was a perforation through which blood had escaped into the peritoneal cavity.

Intestinal perforation is more rare in children than in adults, as might be inferred from the statement already made that intestinal ulceration is less frequent and extensive in them. Statistics show that perforation in children occurs only once in 232 cases. Therefore, as perforation is the common cause of peritonitis in this disease, this inflammation is a rare complication. Peritonitis may, however, occur in typhoid fever without perforation. In one such case (an adult) in the fever wards attached to Charity Hospital local peritonitis with fibrinous exudation occurred opposite two ulcerated patches of Peyer, the ulcers extending nearly to the peritoneum, but not perforating. The lesions observed in this case throw light on those cases of peritonitis complicating typhoid fever which recover, the cause of which has received a different explanation.

In advanced and greatly debilitated cases thrush sometimes appears in the interior of the mouth and upon the fauces. It is always an unfavorable prognostic symptom in children suffering from chronic or protracted disease. Parotiditis is also a rare complication. Otitis, commencing with pain and producing a discharge which may continue for weeks, is not rare, though less frequent than in scarlet fever. The otitis is commonly external, but it may in scrofulous subjects extend to the middle ear.

DIAGNOSIS.—This is more difficult in children than in adults, and the younger the child the greater the difficulty. In infants protracted entero-colitis, with fever and a dry furred tongue, cannot in certain cases be positively diagnosticated from typhoid fever by the symptoms and clinical history. Typhoid fever is believed, however, to be rare at this age, for an infant nourished at the breast is very seldom exposed to the cause of the disease. When, however, as now and then happens, a young child presents the symptoms characteristic of protracted subacute entero-colitis or typhoid fever, and older members of the household have the fever, it is highly probable that the case is one of the latter disease, and it should be treated accordingly.

Even in older children typhoid fever is frequently mistaken for simple subacute enteritis or entero-colitis, or *vice versâ*. The following facts aid in the differential diagnosis: In typhoid fever there is a total loss of appetite, while in the subacute intestinal inflammation food is not entirely refused. Diarrhœa commences early in the inflammation, while in the fever it is not ordinarily till after the lapse of a few days. Abdominal tenderness in the fever is not appreciable or is located in the right iliac region; in the other disease it is general over the abdomen or located in the umbilical region. In typhoid fever there is bronchitis with a cough, which is absent in the inflammation. In typhoid fever there are certain other symptoms, more or fewer of which are present in most cases, and which do not occur in the testinal diseases, except as a coincidence; for example, headache, epistaxis, stupor, delirium, and perhaps the rose-colored spots. The evening rise of temperature and enlargement of the spleen are also important diagnostic symptoms. When it is very important to make a positive diagnosis, cultures may be made from blood drawn from the spleen, from the sediment of albuminous urine, or from the feces, and if the disease be typhoid fever the specific bacillus will be found.

Typhoid fever may be mistaken for meningitis during the first week, but in meningitis there is more constipation, irritability of stomach, and less elevation of temperature. Moreover, in meningitis at a comparatively early stage we are able to detect patches of congestion of the features coming and disappearing suddenly, and slight inequality of the pupils or their oscillation when the light is uniform—signs which are lacking in typhoid fever. In a doubtful case the ophthalmoscope might be employed, which in meningitis discloses congestion of the vessels of the retina, œdema, etc.—anatomical changes which do not pertain to typhoid fever.

The differential diagnosis of typhoid fever and acute tuberculosis may be made by attention to the following points: In tuberculosis there is cough, with some acceleration of respiration from the first, without epistaxis, stupor, or other nervous symptoms, and without the abdominal symptoms which are so prominent in the fever. The occurrence of typical cases in the same house or in those who have been similarly exposed has in certain instances enabled me to make a clear diagnosis.

In localities where diseases due to marsh miasm occur, the remittent fever arising from this cause and typhoid fever bear considerable resemblance to each other. The two, indeed, may coexist—a fact observed during the late Civil War, so that cases in which this coexistence occurred were designated typho-malarial. In malarial remittent fever the commencement is more abrupt, the vomiting and headache more severe, and the remissions more marked than in typhoid fever. Moreover, quinine exerts a decided controlling effect in the fever due to marsh miasm, while its effect in typhoid fever is much less pronounced.

Prognosis.—A much larger percentage of children recover than of adults. Although there be great emaciation with loss of strength, recovery may be confidently predicted, provided that no serious complication occur. Grave symptoms, as high fever, delirium, severe diarrhœa, an unusually rapid and feeble pulse, have a bad import. If from any cause the system is in a marked degree debilitated when the fever begins, the prognosis is much less favorable than in those who are robust. Thus the presence of hereditary syphilis, of tuberculosis, of severe scrofula, or of bronchial or intestinal catarrh when typhoid fever begins, greatly increases the danger. But in fatal cases which I have met the unfavorable result occurred, as a rule, from the complications rather than directly from the malady. Of the complications, the most serious are intestinal ulceration, giving rise to hemorrhage, or even perforation, and consequent peritonitis, diphtheria, pneumonia, nephritis, pleuritis with serous or purulent effusion, meningitis, and granulo-fatty degeneration of the myocardium. Complications like these largely increase the mortality of typhoid fever. The condition in which severe typhoid fever leaves a patient is favorable for the development of tubercles, and now and then they occur, disappointing our expectations and prediction of recovery. The possibility of a relapse should be borne in mind, so that the patient should remain in bed, free from excitement and with plain but nutritious and easily digested diet, until convalescence is well advanced.

Treatment.—Typhoid fever, like typhus, cannot be abridged by treatment, and the indication is to sustain the vital powers, diminish the intensity of the fever, and arrest if possible any untoward symptom or complication. Quinia, so useful in malarial diseases, may be administered in small doses for its tonic effect and as an aid in promoting digestion. It is commonly and properly prescribed in some convenient vehicle for this purpose, but it does not antagonize the typhoid as it does the malarial poison. Perturbating medicines, and especially cathartics, should be given with caution. The tendency to intestinal ulceration and hemorrhage and the anæmic nature of the fever require abstinence from or cautious use of such agents. A temperature remaining under 103° usually involves little danger. If it remain above 103° morning and evening, antipyretic measures should be employed. I therefore order the nurse to bathe frequently the forehead, face, hands, arms, neck, and sometimes the chest, with cold water, to which it is proper to add alcohol or some spirituous lotion. A cloth wrung out of ice-water or an ice-bag should be applied over the head, and the hands may be allowed to lie a considerable time in a washbowl containing the lotion, which is always grateful to the patient. The water treatment thus applied will usually reduce the temperature one, two, or three degrees within a few hours. Cold general baths are not so well tolerated by children as by adults. Collapse has sometimes followed their use, and, on the other hand, benefit has apparently in some cases accrued from their employment when the temperature was above 104°. The bath, if used, should be at a temperature of about 88°, and the patient should not be immersed in it longer than five to eight minutes (Henoch). It seems preferable, however, in most cases of high temperature, to endeavor to reduce it by cold sponging or cold compresses. A compress frequently wrung out of ice-water or containing broken ice mixed with bran, or a rubber ice-bag applied over the head and another over the abdomen, or Leiter's coils applied over the same parts as the compress, gradually abstract the heat, and with more safety to the patient than the use of the cold bath. Ice applications should be discontinued if the temperature fall to 103° or if the patient complain of chilliness. Even an afternoon temperature of 104° does not require ice applications or any active antipyretic, provided there is a decided morning remission. Moderate doses of quinine and general sustaining remedies suffice for such cases.

Of the internal antipyretics, sodium salicylate, antipyrine, phenacetin, acetanilide, and quinine have been chiefly employed. The sodium salicylate is likely to retard digestion, and it sometimes causes albuminuria. Its use, therefore, cannot be recommended. Antipyrine effectually reduces the temperature, but is depressing. It may be given, especially in the early stages of typhoid fever, in doses of two to five grains according to the age, along with an alcoholic stimulant, with a good result. Some physicians recommend the use of phenacetin instead of antipyrine, as being equally effectual and less depressing. It may be given in about half the dose of antipyrine. Acetanilide in one-fourth the dose of antipyrine also reduces the fever, but it is also depressing, and it does not, so far as I am aware, possess any advantages over antipyrine. In the majority of cases the reduction of temperature is best effected by cold-water bathing, or cold compresses and the internal use of quinine. Quinine in moderate doses as a tonic appears to be useful during the entire course of the fever, but in cases of a temperature dangerously high antipyrine, acetanilide, or phenacetin is now preferred by good observers to the use of large doses of quinine, which were formerly employed (Von Ziemssen).

The fact that in a large proportion of cases the typhoid bacillus enters the system in the ingesta, and effects a lodgment upon the gastro-intestinal surface, suggests the query whether the early use of antiseptics administered by the mouth might not be destructive to the bacillus, and thus in a measure destroy the cause of the disease. The remedy which has thus far been used for this purpose, and which is supposed by some to exert a specific action upon the disease, apart from its purgative or eliminative effect, is calomel. Its mode of action is not fully understood. It is supposed by some to be in part changed into the bichloride in the stomach and intestines. Von Ziemssen in treating adults administers early in the attack three 7½-grain doses of calomel at intervals of two hours, and obtains by so doing a considerable reduction of temperature during the following twelve hours. Liebermeister claims that the use of calomel diminishes the intensity of the disease, and Wunderlich even believed at one time that it might abort the fever. On the other hand, Weil, Griesinger, and Baumler assert, from their observations and statistics, that the mortality is not diminished nor is the number of aborted cases increased by the use of calomel, and that it is only useful as a mild, non-irritating evacuant. Wilson says: "Attempts to fix the hypothetical specific action by long-continued calomel treatment, and to force a true abortive calomel treatment, have at different times failed, as has also the sublimate treatment of typhoid fever." The use of calomel should probably be restricted to one or a few doses at the commencement of the attack.

Since it is impossible to arrest typhoid fever or abridge its duration by any therapeutic measures of which we are cognizant, the indication is to sustain the vital powers and alleviate, so far as possible, the symptoms. Quinine is not only employed in large doses to reduce the fever, but it is often prescribed in small doses during the subsequent progress of the disease, in the belief that it may exert some tonic effect. It does not appear, however, to exert any marked controlling effect upon the symptoms. Iodine, iodide of potassium, and carbolic acid have also been employed internally, but their efficacy is doubtful, but Liebermeister states that the iodide of potassium employed in two hundred cases, although it did not appreciably ameliorate the symptoms, apparently diminished the mortality.

The mineral acids have also their advocates, and statistics appear to show benefit from their use. The late Prof. Austin Flint treated 78 patients with the acids with a death-rate of 10.25 per cent. and 70 patients without the acids with a death-rate of 20 per cent., the treatment otherwise of the two classes being alike. The mineral acid which, in my opinion, is most useful is the muriatic, since it aids digestion, which is greatly impaired by the fever, and since the digestive ferments in this disease are apparently secreted in insufficient quantity. I usually prescribe this acid with pepsin, as in the following formula:

℞. Pepsini puri, in lamellis, ʒj;
Acidi muriat. dilut., ʒij;
Syr. simplic., ℥j;
Aquæ, ℥iij. Misce.

Give one teaspoonful in water every two hours to a child of ten years. The wine of pepsin of the National formulary may also be employed, but each teaspoonful contains only about one minim of the dilute muriatic acid, so that the quantity of the acid might be increased.

In all but the mildest cases alcoholic stimulants are required, especially after the first week. In the first week they may be withheld in ordinary cases, but in attacks of a severe type and attended by early prostration they may be required at or soon after the commencement of the fever. The indications for their use are feeble pulse with faint systolic sound and marked nervous symptoms, as subsultus tendinum, stupor, and delirium. In the prostration consequent on high fever and protracted and obstinate diarrhœa the use of alcohol is important as a cardiac stimulant. Still, such large and frequent doses of the alcoholic compounds are not needed as are useful in diphtheria. The object in employing them is to sustain the flagging pulse and promote digestion and assimilation. The preferable mode of employing alcoholic stimulants is in the form of milk punch or wine whey.

Wakefulness, which is sometimes an unpleasant symptom, and which may occur with, and is perhaps largely due to, the headache, may be relieved by a powder of phenacetin and bromide of potassium or sodium, two to five grains of the former and double or treble its amount of the bromide. The new remedy, sulphonal, triturated and given in sweetened water or milk, will also relieve the insomnia, and in some instances it appears to be preferable to the other agents which have been employed for the purpose of procuring sleep. An opiate, as Dover's powder, is also useful in relieving wakefulness, and should be prescribed if the patient at the same time have diarrhœa. Three grains may be given to a child of eight years. For headache, whether accompanied by wakefulness or not, I know no better remedy than phenacetin in combination with the bromide of potassium or sodium, as given above. At the same time, cool lotions should be applied to the head. The same remedies which are appropriate for the insomnia are also useful for the delirium which occasionally occurs in cases of a grave type. The constant application of cold to the head and an increase in the stimulation may also be required.

We have stated elsewhere that diarrhœa is less common in the typhoid fever of children than in that of adults, but it sometimes occurs, and should be promptly checked. The subnitrate of bismuth in rather large and frequent doses, along with an opiate and vegetable astringent, will usually control the diarrhœa, and the same remedies should be employed in intestinal hemorrhage. Recently in my practice in the case of a boy of about fifteen years near the close of the second week of typhoid fever, so large a flow of blood occurred from the intestines that the condition of the patient was very critical. But the loss of blood was quickly checked by large doses of subnitrate of bismuth and teaspoonful doses of equal parts of the camphorated tincture of opium and tincture of catechu, and the patient recovered. The constipation which is sometimes present in typhoid fever, and more frequently in children than in adults, may be relieved by an enema of water, half a pint containing one or two teaspoonfuls of glycerin.

The distension of the stomach and intestines with flatus is sometimes so great that it requires treatment. It may cause a sensation of fulness and prevent the descent of the diaphragm in respiration, and it increases the danger of perforation if a deep intestinal ulcer exist. External pressure and manipulation should not be employed under such circumstances, since they might cause rupture, nor should the hypodermic needle be used. Jacobi has witnessed a fatal peritonitis produced by the escape of fecal matter through the punctures caused by the needle (*Arch. of Pediatrics*, Dec., 1888). The proper remedy for the flatus is either turpentine or the aniseed cordial of the National Formulary.

Sustaining measures are of the highest importance. Typhoid fever ceases after some days or weeks with or without medicinal treatment, and the patient recovers if the strength be adequately supported. Hence the food should be sufficient in quantity, of the most nutritious kind, and easily digested and assimilated. It must be liquid, since the repugnance to food and the mental state of the patient render it impossible to feed him with solids unless in the mildest cases. Milk sterilized by heat or peptonized, the meat broths, and gruels with milk must be the food chiefly employed. Since the digestive ferments are apparently secreted in small quantity during the fever and diges-ion is feebly performed, it is well to employ predigested food when the disease is unusually severe and the temperature very high. Peptonized milk and the beef peptones of the shops are useful under such circumstances. Milk with some farinaceous food long boiled, as barley flour, should in most instances be employed as the principal article of diet. The mistake is sometimes made by anxious friends of giving the nutriment too frequently, even every half hour. As in health, so in this disease, the digestive function requires intervals of rest, so that, as a rule, the food should not be given oftener than every two hours, and then in sufficient quantity. A dose of pepsin before each feeding, employed in the formula recommended above, has been useful in critical cases in my practice. So important is the diet in typhoid fever that the physician neglects an important duty if he do not give as full and explicit directions in regard to the feeding as he does in reference to the use of medicines. The room occupied by the patient should be large and well ventilated. Statistics show that the result is far better if there be a plentiful supply of pure fresh air than in closed and ill-ventilated apartments; so that in some of the hospitals patients are treated in canvas tents upon the hospital grounds when the weather is suitable. Nearly forty years ago an emigrant-ship arrived at Perth Amboy, N. J., with more than 300 passengers, 82 of whom were sick with fever, and several had died at sea. There being no hospital in the town, the fever patients, 12 of whom were insensible, were placed in hastily-constructed wooden shanties with sail roofs. To add to their discomfort, a violent thunder-storm occurred which drenched the interior of the shanties, and yet with simple medicinal treatment and the use of buttermilk and animal broths only 1 of the 82 patients died. Four sailors who sickened with the fever after the arrival of the vessel were taken to a dwelling-house, and two of them died. These facts, which were related to the New York Academy of Medicine at the June meeting in 1853 by the late Dr. John H. Griscom, and were published in the Transactions of the Academy for that year, strongly impressed the profession of New York with the importance of fresh air in the treatment of typhus and typhoid fevers, and the knowledge thus obtained has no doubt been instrumental in saving many lives. But in the treatment of children the sudden reduction of temperature and currents of cold air should be avoided, for by taking cold the bronchial catarrh which is ordinarily present in a mild form might be aggravated, or a croup or pneumonia might be developed.

Von Ziemssen states that in severe cases attended by feeble heart-action the patient should not be allowed to move without assistance or get out of bed, for sudden heart-failure and death "frequently result from a neglect of this rule" (*Annual of Med. Sci.*, vol. i., 1888). The occurrence of bed-sores should be guarded against by change of position and the use of a soft mattress or water-bag. In severe cases attended by much prostration the patient should not be allowed to leave the bed until some days after the fever has ceased and the strength is in a measure restored.

Prophylaxis.—The duty of the physician does not cease with the care of the patient. He should employ efficient measures to prevent the propagation of the disease. Especial attention should be given to the disinfection of the excreta. This may be accomplished by adding six ounces of chloride of lime to one gallon of water, and mixing one quart of this solution with each fecal evacuation and a less quantity with each urinary discharge. Crude carbolic acid (one part to ten or fifteen of water), sulphate of copper (one part to twenty of water), or, best of all, corrosive sublimate (one part to two hundred to four hundred of water) may be employed for the same purpose. The disinfected discharge should be allowed to stand a few moments before it is emptied into the water-closet, and the closet should be thoroughly flushed the use of alcohol is important as a cardiac stimulant. Still, such large and frequent doses of the alcoholic compounds are not needed as are useful in diphtheria. The object in employing them is to sustain the flagging pulse and promote digestion and assimilation. The preferable mode of employing alcoholic stimulants is in the form of milk punch or wine whey.

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out. In country practice great care must be taken that the discharges be not emptied in such a place that they can by any possibility percolate into the well which supplies the drinking water to the families or neighbors. A pound or more of corrosive sublimate in solution should be sprinkled in the vault, and chloride of lime should be dusted over the contents. The milk used in the family should be sterilized by steaming two hours at a temperature of 180° to 190°, or by boiling, and the drinking water should be boiled or distilled. Care should be taken to disinfect promptly the clothing worn by the patient and the bedding. This may be accomplished by placing them immediately when removed in boiling water or by immersing them in a solution of corrosive sublimate (one part to one thousand), or carbolic acid (one part to fifty), or sulphate of copper or chloride of lime (one part to one hundred).

CHAPTER IV.

CEREBRO-SPINAL FEVER.

Definition.—Probably a microbic disease. It is manifested chiefly by the occurrence of cerebro-spinal meningitis. Its prominent symptoms are such as meningitis gives rise to—to wit, fever, headache, tonic contraction of the muscles of the nucha, hyperæsthesia, and neuralgic pains in the trunk and extremities. It is non-contagious or contagious in a very low degree, and, as with most of the microbic diseases, its victims are chiefly the young. It is ordinarily a primary disease, but it sometimes occurs as a complication of other acute as well as chronic maladies. It begins abruptly or without a premonitory stage, and it is often speedily fatal from the intense hyperæmia of the nervous centres or the severity of the cerebro-spinal meningitis. In other cases, after weeks or months of suffering and progressive loss of flesh and strength, death occurs in a state of extreme prostration. In those who recover convalescence is protracted and slow.

This disease has been designated by different terms in different countries, as spotted fever, cerebro-spinal fever, malignant purpuric fever, typhus petechialis, typhus syncopalis, and febris nigra, expressive of its constitutional nature. Those who employ such terms regard it as a general or systemic disease, with the meningitis as its local manifestation, just as pharyngitis is a local manifestation of scarlet fever or bronchitis of measles or pertussis. This opinion of its nature receives strong support from the clinical fact that in severe forms of the disease extravasations of blood occur early under the skin, indicating a profoundly altered state of the blood and systemic infection. The disease has also been designated by terms expressive of its local nature, as epidemic meningitis, epidemic cerebro-spinal meningitis, typhoid meningitis, malignant meningitis. We will treat hereafter of the nature of this malady, and endeavor to justify the opinion which has led to the use of terms that indicate its constitutional character.

History.—Whether cerebro-spinal fever occurred previously to the present century is uncertain. If it did it was confounded with other diseases. Vieussens in 1805 was apparently the first who wrote a clear and unmistakable description of it, designating it "a malignant non-contagious fever." He described an epidemic of it which appeared in Geneva, Switzerland, in a family of 3 children, of whom 2 died in twenty-four hours. Two weeks later 4 children in another family died of it, after an illness of less than a nd a young man in another house died with similar symptoms after an lly brief illness, his surface having a deeply congested or violet appear-

In these and subsequent cases the attack began in the latter part of day or at night, and was attended by vomiting, violent headache, convul- , dysphagia, petechiæ, and tonic contraction of the posterior muscles of neck and trunk, producing retraction of the head and opisthotonos. ty-three lost their lives during this epidemic, after a sickness varying twelve hours to five days. Within the next two years epidemics of ebro-spinal fever occurred in Bavaria, Holland, Germany, and at about same time or soon after in parts of England.

The first American cases of the disease, so far as is now known, were at Deerfield, Massachusetts, in 1806. From 1806 to 1816 occasional outbreaks it occurred in England, France, and America in several localities. It appeared in both Canada and the United States. From 1816 to 1828, so far is now known, only two epidemics of it occurred, and they were limited to small areas and were of brief duration. The one was at Middletown, Connecticut, and the other at Vesoul, France. In 1828 it occurred in Trumbull County, Ohio, in 1830 at Sunderland, England, and in 1833 at Naples. After the Naples epidemic a respite from the disease appears to have occurred, in both the Eastern and Western Hemispheres, until 1837. In that year it appeared in the South of France, in and around Bayonne, and gradually extended to isolated localities over almost the whole of France. It occurred at this time among troops in their barracks as well as civilians, and in some localities of the troops affected from 50 to 75 per cent. died. Even Versailles and Paris did not escape. During the twelve years from 1837 to 1849, France suffered far more than any other country from this disease. It was especially common and fatal among the soldiers in many localities, and at some of the military stations in France several successive epidemics occurred. In the decade from 1839 to 1849 cerebro-spinal fever extended to Naples, the Romagna, Sicily, Gibraltar, Algeria, and various places in Denmark, England, and Ireland.

In 1842 the United States was again visited by cerebro-spinal fever in localities at a distance from the seaboard, and therefore, apparently, not by communication from Europe. In 1842–43 it occurred in Kentucky, Tennessee, Alabama, Illinois, Mississippi, and Arkansas. From 1840 to 1850 it visited Montgomery in Alabama, Beaver county in Pennsylvania, Cayuga county in New York, and New Orleans in Louisiana. Between 1850 and 1854 there is no record of its occurrence in either hemisphere, but from 1854 to 1860 it ravaged the Scandinavian peninsula and caused more than four thousand deaths.

Since 1860 certain localities in nearly every civilized country have been severely visited by this disease. In all these countries it is justly regarded as one of the most fatal and important of the epidemic maladies.

An interesting fact in regard to these many epidemics on both continents, which have been reported by competent observers, is that they have occurred in isolated localities far apart and without the least evidence of transportation. Cerebro-spinal fever has not, so far as I am aware, in any instance extended from one locality to an adjacent one in the manner of contagious diseases. The cause of the malady has evidently arisen or been created in the places where the cases have occurred, and is not susceptible of transportation so as to produce the disease elsewhere. Cerebro-spinal fever resembles in this respect the diseases due to marsh miasm.

But since 1860 this disease has appeared in this country in another phase. It has become or is being established—or, to use the phrase commonly *employed in medical literature*, naturalized—in the cities of the United States.

For some years not a week has passed without the report of deaths from this cause in New York, Philadelphia, Jersey City, and Chicago. It is probably already permanently established in Cincinnati, St. Louis, Minneapolis, Newark, and San Francisco, since deaths from it have been reported it these cities during many consecutive weeks.

In New York City prior to 1866 only 4 deaths occurred from what was perhaps cerebro-spinal fever, since in 1838 2 deaths were reported from so-called spotted fever, 1 in 1850 and 1 in 1861. What was the nature of this spotted fever is now a matter of conjecture. In 1866, 18 patients died of cerebro-spinal fever within the city limits, and not a year has passed since, and in the last few years not a week, without deaths from it. From 1866 to 1872 the annual deaths from this disease in New York varied from 18 to 48. Commencing in December, 1871, and continuing during the first half of 1872, a severe epidemic occurred, producing a large mortality. Many who recovered permanently lost their hearing and some their sight from the attack. In this epidemic the physicians of New York were fully aroused to the importance of the disease which was causing so much suffering, and which attacked the lower animals, especially the jaded horses of the city car- and stage-lines, not a few of them dropping down in harness, so suddenly did the attacks occur. In 1872, 782 deaths, chiefly of children, resulted from cerebro-spinal fever within the city limits. This epidemic appeared to produce a greater dissemination of the disease and more firmly established it in the city, for since then the annual deaths from it have varied between 97 in 1878 and 461 in 1881. In Philadelphia cerebro-spinal fever began in 1863, causing 49 deaths in that year, and it has never been absent from that city since. Prof. Stillé states that between 1863 and 1882 it has caused 2049 deaths within the city limits. In Philadelphia, as in New York, it has for some years produced a nearly uniform weekly mortality. The prevalence of cerebro-spinal fever in the United States and its probable importance in the future may be inferred from the fact that it has recently occurred also in Cincinnati, Minneapolis, Denver, Norfolk, Boston, Worcester, New Haven, Albany, Syracuse, Auburn, Milwaukee, Wilmington, Detroit, Baltimore, Charleston, Toledo, Mobile, Salt Lake, Grand Rapids, Providence, Chattanooga, Hartford, New Orleans, Fall River, Richmond, Knoxville, and Nashville.

ETIOLOGY.—That this disease is produced by a micro-organism is generally believed. Dr. A. Fränkel and other European microscopists have carefully examined the bacteria found in the blood and tissues of those affected by it. At a meeting of the Berlin Medical Society, held February 12, 1883, Herr Leyden showed under the microscope specimens of micrococci found in a case of cerebro-spinal fever. They had an oval shape, were mostly in pairs, and were faintly tremulous. They resembled those found in pneumonia and erysipelas, but Leyden did not think them identical. At the same meeting Herr Baginsky related cases which seemed to show that in some instances the cause of cerebro-spinal fever and that of pneumonia might be identical.[1]

Dr. V. O. Pushkareff, connected with one of the barrack-infirmaries of St. Petersburg, states that in five cases of croupous pneumonia in which cerebro-spinal meningitis occurred as a complication he discovered in the pus taken from the cerebral meninges swarms of micrococci whose appearance under the microscope seemed identical with that of Friedländer's pneumococcus. They were either isolated or in groups of two, seldom in four, having distinct capsules, and they were absent from the fluid taken from the meninges in simple pneumonia. Pushkareff was able to cultivate the micrococ-

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[1] *Deutsch. med. Wochenschr.*, April 4, 1883.

Is Cerebro-Spinal Fever Contagious?

It is the almost unanimous opinion of those who are most competent to judge from their observations that it is either not contagious or is contagious in a very slight degree. It is certain that the vast majority of cases occur without the possibility of personal communication. Thus, in the commencement of an epidemic the first patients are affected here and there at a distance from each other, often miles apart, and throughout an epidemic usually only one is seized in a family. Children may be around the bedside of the patient, passing in and out of the room without restriction, and yet we can confidently predict that none of them will contract the malady if there be proper ventilation and cleanliness and none of the conditions of insalubrity exist within or around the domicile. Moreover, when multiple cases occur in a family the disease begins at such irregular intervals in the different patients that there can be little doubt in most instances that it is not communicated from one to the other, but, like the fevers from marsh miasm, is produced by exposure to the same morbific cause, existing outside the individuals, but within or around the premises. Thus, in the Brown family treated by the late Dr. John G. Sewell[1] of New York, the first child sickened January 30th, and subsequently the remaining five children at intervals respectively of five, seven, eleven, twenty-five, and forty-five days. That so many were affected in one family was attributed by the doctor to the filthy state of the house and the bad plumbing, which allowed the free escape of sewer-gas. In my own practice, in the family which suffered the most severely of all, four patients were seized in succession, and yet I could see no evidence of contagiousness. The family occupied a small plot of ground, not more than thirty feet by one hundred, and their occupation was to prepare for the meat-market what is known as head-cheese. They lived on the second floor of the two-story wooden house in which the work was carried on. At the time of the sickness the shop contained four hundred heads of animals from which the meat for the cheese was obtained, and it was evident that decaying animal matter was present. The occupation and surroundings of this family afforded sufficient explanation of the fact that so many were attacked. Two workmen contracted the disease within about one week of each other, and were removed from the house. On January 26th, four weeks after the commencement of the malady in the workman who was first attacked, one child sickened with it, and died on February 1st. Fifteen days subsequently (February 16th) a second child was attacked, and, after a tedious sickness, finally recovered. The long and irregular intervals between these cases indicate that the disease was not contracted by one from the other. The important factor in causing so severe an outbreak of cerebro-spinal fever in this family was probably the miasm produced by such an occupation in the house where the family resided, with neglect of ventilation and cleanliness.

But the strongest evidence that cerebro-spinal fever is either noncontagious or very feebly contagious is afforded by the fact that a large majority of the cases occur singly in families, although there is no isolation of the patients. The following are the statistics relating to this point in the cases which I have observed since cerebro-spinal fever commenced in New York, in 1871: Single cases occurred in seventy families; dual cases occurred in nine families; three cases occurred in one family, and four cases in one family. Intercourse with the sick-room was unrestricted in all these families, so that children frequently went out and in, and sometimes assisted in the nursing.

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[1] *Medical Record*, July, 1872.

e most striking example of apparent contagiousness which has come
knowledge was related by Hirsch, and is quoted by Von Ziemssen.
ung man sickened with cerebro-spinal fever on February 8th. The
n who nursed him returned to her home in a neighboring village, and
died of the same disease on February 26th. To her funeral mourners
from a neighboring township, and after their return home three of them
with the same disease—one within twenty-four hours, another on March
and a third on the 7th.

n one instance only in my practice did the facts point to contagiousness.
y of twelve years died of cerebro-spinal fever, and was buried on Satur-
or Sunday. On Monday the mother washed the linen and bedclothes of
boy, which had accumulated and were in a very filthy state. Two days
equently she was attacked, and her infant soon afterward, both perishing.
state of the bedding and apartments in this house, as seen by myself,
such as would be likely to concentrate and intensify the poison, render-
t peculiarly active, for they were very dirty, and the mother, exhausted
er long and incessant watching and lack of sleep, and depressed by grief,
red her system more liable to the disease by her self-imposed duties on
ay after the funeral. One in her state of mind and body, standing for
siderable part of a day over the bedclothes and bedding of her child
by the excreta, would certainly be in a condition to contract the disease
were contagious in any, even in the lowest, degree. In the present state
r knowledge, therefore, upon this important subject the evidence leads
believe that with proper ventilation and cleanliness and the suppression
tihygienic conditions in an infected domicile those who are in a good
of body and mind will not contract the disease, but in the opposite con-
s it is not improbable that the poison may be so intensified, and the sys-
endered so liable to receive the prevailing malady through impairment
e general health and diminished resisting power, that cerebro-spinal
may, though rarely, be communicated either by the breath of the patient
exhalations from his surface or from soiled clothing.

he occurrence of cerebro-spinal fever in certain of the lower animals is
y interesting fact, especially as the question is sometimes asked whether
y not be communicated from them to man. In the epidemic of 1811 in
ont, according to Dr. Gallop, even the foxes seemed to be affected, so
they were killed in numbers near the dwellings of the inhabitants.
ro-spinal fever, previously unknown in New York City, began, as stated
e, in 1871, among the horses in the large stables of the city car- and
-lines, disabling many and proving very fatal, while among the people
pidemic did not properly commence till January, 1872, although a few
ed cases occurred in December of 1871. No evidence exists, so far as
aware, that the disease was in any instance communicated by these
ls to man. Those who had charge of the infected horses, as the veter-
surgeons and stable-men, did not contract the malady, certainly not
frequently than others who were not so exposed. Although we may
t slight contagiousness, there has probably been no well-established
ple of the transmission of cerebro-spinal fever from animals to man.
nsmission ever does occur, it is so rare that practically no account need
ade of it.

n some instances we are able to discover an exciting cause. An indi-
l whose system is affected by the epidemic influence may perhaps escape
quiet and regular mode of life, but if there be any unusual excitement
the normal functional activity of the system be seriously disturbed, an
eak of the malady may occur. Among the exciting causes we may
ion overwork and lack of sleep, fatigue, mental excitement, depressing

emotions, prolonged abstinence from food followed by over-eating, and the use of indigestible and improper food. Thus, in once instance among my cases a delicate young woman, at the head of one of the departments in a well-known Broadway store, was anxious and excited and her energies overtaxed at the annual reopening. Within a day or two subsequently the disease began. Another patient, a boy, was seized after a day of unusual excitement and exposure, having in the mean time bathed in the Hudson when the weather was quite cool. Those children have seemed to me especially liable to be attacked who were subjected to the severe discipline of the public schools, returning home fatigued and hungry, and eating heartily at a late hour. In one instance which I observed a school-girl ten years of age returned from school excited and crying because she had failed in her examination and had not been promoted. In the evening, after she had closely studied her lessons, the fever began with violent headache.

Dr. Frothingham[1] writes as follows of the brigade in which cerebro-spinal fever occurred in the Army of the Potomac: "Under General Butterfield, a stern disciplinarian, ... the men were drilled to the full extent of their powers, often to exhaustion. I did not at the time recognize this as the cause of the disease in question, but I learnt that in the present epidemic in Pennsylvania the attack generally follows unusual exertion and exposure to cold."

Many observers have noticed that bodily fatigue and mental depression and excitement are important factors in causing an attack of cerebro-spinal fever when this disease is epidemic. Dr. Gallop, in his history of cerebro-spinal fever as it occurred during the war of 1812, directs attention to the severity of the cases among the troops under General Dearborn, who were fatigued by marches and greatly dispirited on account of a repulse which they had sustained from the British. In one case which occurred in my practice a boy, six years and eleven months of age, was punished at school and came home with cheeks flushed from excitement, the excitement continuing during the ensuing night. On the following day cerebro-spinal fever began with vomiting and chilliness, the attack ending fatally on the seventeenth day. In another case, which was related to me by the mother and the physician, the patient, a bright girl twelve years of age, of nervous temperament and forward in her studies, had been much excited in competing for a prize in athletic exercises. In the evening of the same day a violent thunder-storm occurred, and after a severe clap she started from bed pallid and excited, and expressed the belief that she had been struck by lightning. The disease began immediately after this, and terminated fatally on the fifth day.

SECONDARY CEREBRO-SPINAL FEVER.

Fagge[2] says: "Several observers have found that during or just after an epidemic of cerebro-spinal fever meningitis has presented itself with unusual frequency as a complication of other acute diseases." He mentions croupous pneumonia, pleurisy, acute tonsillitis, and scarlatinal nephritis as the diseases upon which it is very liable thus to supervene. In this respect cerebro-spinal fever resembles diphtheria and erysipelas, which we know are very liable to occur in those who are suffering from other diseases.

A striking example of cerebro-spinal fever occurring as a complication was recently seen by me in consultation. A child of about ten years with typical typhoid fever had reached about the twelfth day of a mild form of isease. The initial headache had ceased, there was no delirium, the rature was but moderately elevated, and no doubt had arisen in the of the experienced physician in attendance that the disease, which nted the characteristic signs, would terminate favorably after the usual Suddenly violent headache occurred, the temperature rose to 103° or F., and in a few days fatal coma terminated the case. Another disease hich I have seen cerebro-spinal fever occur as a complication is gastrotinal catarrh.

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[1] *American Medical Times*, April 30, 1864.

[2] *Practice of Medicine*, vol. i. p. 614.

EX.—It is stated by certain writers that more males are affected than les. The statistics of hospitals and camps show this, for men subject ves of hardship are especially liable to be attacked; but in family prac- in which a large proportion of the patients are children, the number of s and females is about equal. Thus, in 105 cases occurring chiefly in practice, but a few of them in the practice of two other physicians of city, I find that 59 were males and 46 females: 91 of these were children. New York City, during the epidemic of 1872, 905 cases of cerebro-spinal er were reported to the Board of Health between January 1 and Novem- 1, and of these 484 were males and 421 females. Dr. Sanderson's istics of the epidemic in the provinces around the Vistula, the cases g chiefly children, give also but a slight excess of males. Probably, there-, in the same conditions and occupations of life the sexes are equally le to contract this malady, and the excess of males is due to the fact that lead a more irregular life and are more subject to privations and osures. That soldiers on duty in barracks have been attacked while ilies in the vicinity escape, thus increasing the proportion of male cases, st be due to irregularities, hardships, and perhaps the lack of sanitary ulations in their mode of life.

AGE.—My observations lead me to think that the younger the patient more frequently is cerebro-spinal fever overlooked and some other disease gnosticated. Nevertheless, all published statistics, so far as I am able to ertain, show that a large proportion of cases occur under the age of five rs, and that a larger proportion of fatal cases are in the first year of life n in any other year. Thus, in New York City the ages of those who died m this disease in 1883 were as follows:

Under 1 year	57	From 20 to 25 years	7
From 1 to 2 years	31	From 25 to 30 "	3
From 2 to 3 "	22	From 30 to 35 "	4
From 3 to 4 "	12	From 35 to 40 "	3
From 4 to 5 "	9	From 40 to 45 "	1
From 5 to 10 "	37	From 45 to 50 "	2
From 10 to 15 "	18	From 50 to 60 "	1
From 15 to 20 "	15	Over 60 years	1

following are the statistics of the New York Health Board relating to ages of the cases during the epidemic of 1872:

Under 1 year	125	From 15 to 20 years	54
From 1 to 5 years	336	From 20 to 30 "	79
From 5 to 10 "	204	Over 30 years	71
From 10 to 15 "	106	Total	975

the cases which occurred in my own practice, and in a few cases in the ctice of other physicians added to mine, I find that the ages were as ows:

Under 1 year	16	From 10 to 15 years	10
From 1 to 3 years	27	Over 15 years	15
From 3 to 5 "	25	Total	113
From 5 to 10 "	20		

In my practice, therefore, three-fourths of the cases have been under the age of ten years; and the statistics of epidemics in other localities correspond with mine in giving a large excess of cases in childhood. Thus, Dr. Sanderson, in examining the records of deaths in one epidemic, ascertained that 218 had perished under the age of fourteen years, and only 17 above that age; and although this does not show the exact ratio of children to adults in the entire number of cases, it is evident that the children were greatly in excess.

The more advanced the age after the tenth year, the less the liability to this malady, so that very few who have passed the thirty-fifth year are attacked, and old age possesses nearly an immunity. In New York City, in which, as we have seen, cerebro-spinal fever has been occurring since 1871, only two cases have come to my knowledge which had passed the fortieth year. The age of one was forty-seven, and of the other sixty-three years. But nearly every year the statistics of the Health Board show that one or two old people have died of this disease.

Not a few cases occur in this city in infants of the age of three or four months. An infant of four months died of cerebro-spinal fever in the New York Infant Asylum, the nature of the disease not being known until it was revealed by the autopsy.

SYMPTOMS.—During the prevalence of cerebro-spinal fever cases now and then occur in which the symptoms are mild and transient and the health is soon fully restored. It seems proper to regard some, at least, of these as genuine but aborted forms of the disease. The following cases which occurred in my practice may be cited as examples:

A boy eight years of age, previously well, was taken with headache and vomiting, attended by moderate fever, on April 2, 1872. The evacuations were regular, and no local cause of the attack could be discovered. On the following day the symptoms continued, except the vomiting, but he seemed somewhat better. On April 4th the fever was more pronounced, and in the afternoon he was drowsy and had a slight convulsion. The forward movement of the head was apparently somewhat restrained. On the 6th the symptoms had begun to abate, and in about one week from the commencement of the attack his health was fully restored.

A boy aged six was well till the second week in May, 1872, when he became feverish and complained of headache. At my first visit, on May 14th, he still had headache, with a pulse of 112. The pupils were sensitive to light, but the right pupil was larger than the left. The bromide and iodide of potassium were prescribed, with moderate counter-irritation behind the ears. The headache and fever in a few days abated, the equality of the pupils was restored, and within a little more than one week from the commencement of the disease he fully recovered.

These cases occurred when the epidemic of 1872 was at its height; but if the symptoms are so mild and the duration of the disease short as in these two cases, the diagnosis must sometimes be doubtful. Observers in different epidemics report similar cases, and as the symptoms, so far as they appeared in my patients, seemed charcteristic, I have not hesitated to regard them as genuine but aborted cases. On such patients the epidemic influence acts so feebly or their ability to resist it is so great that they escape with a short and trivial ailment.

Occasionally also during the progress of an epidemic we meet patients who present more or fewer of the characteristic symptoms, but in so mild a form that they are never seriously sick and never entirely lose their appetite, but the disease, instead of aborting, continues about the usual time.

Thus, on January 4, 1873, I was called to a girl aged thirteen who had been seized with headache, followed by vomiting, in the last week in December. During a period of six to eight weeks, or till nearly March 1st, she had the following symptoms: daily paroxysmal headache, often most severe in the forenoon; neuralgic pain in the left hypochondrium, and sometimes in the epigastric region; pulse and temperature sometimes nearly normal, and at other times accelerated and elevated, both with daily variations; inequality of the pupils, the right being larger than the left during a portion of the sickness. The patient was never so ill as to keep the bed, usually sitting quietly during the day in a chair or reclining on a lounge, and she never fully lost her appetite. Quinine had no appreciable effect on the fever or paroxysms of pain.

There can, in my opinion, be little doubt that this girl was affected by the epidemic, but so mildly that there was, for a considerable time, much uncertainty in the diagnosis.

Cases like these, in which the disease is so feebly developed that the patient is never seriously sick, though unimportant pathologically, must be recognized in a treatise on cerebro-spinal fever.

Mode of Commencement.—Cerebro-spinal fever rarely begins in the forenoon after a night of quiet and sound sleep. In the cases which I observed in the severe and fatal epidemic of 1872, and in the 36 cases of which I have records observed since 1872, the commencement was almost without exception between midday and midnight. The fact that this disease does not commence after the repose of night till several hours of the day have passed shows the propriety and need of enjoining a quiet and regular mode of life, free from excitement and with sufficient hours of sleep, during the time in which the epidemic is prevailing.

The commencement is usually without premonitory stage and sudden —unlike, therefore, the beginning of other forms of meningitis, which come on gradually and are preceded by symptoms which, if rightly interpreted, direct attention to the cerebro-spinal system. Exceptionally certain premonitions occur for a few hours or days before the advent of the disease, such as languor, chilliness, etc. Mild cases more frequently begin gradually and with certain premonitions than severe cases. The ordinary mode of commencement is as follows: The patient is seized with vomiting, headache, and perhaps a chill or chilliness, so that there is a sudden change from perfect health to a state of serious sickness. Rigor or chilliness is a common initial symptom, especially in adult patients. One patient, an adult female, had three or four chills of considerable severity in the commencement of the attack. Children often have clonic convulsions in place of the chill or immediately after it, partial or general, slight or severe. Stupor more or less profound, or less frequently delirium, succeeds. In the gravest cases semi-coma occurs within the first few hours, in which patients are with difficulty aroused, or profound coma, which, in spite of prompt and appropriate treatment, is speedily fatal. Those thus stricken down by the violent onset of the disease if aroused to consciousness complain of severe headache, with or without or alternating with equally severe neuralgic pains in some part of the trunk or in one of the extremities. The pain frequently shifts from one part to another. Among the early symptoms of cerebro-spinal fever are those which pertain to the eye. The pupils are dilated or less frequently contracted, and they respond feebly or not at all to light if the attack be severe or dangerous; often they oscillate, and occasionally one is larger than the other. Vomiting with little apparent nausea, and often projectile, is common in the commencement of cerebro-spinal fever. It occurred as an early symptom in 51 of 56 cases observed by Dr. Sanderson. In 97 cases occurring in New York, most of them observed by myself, but a few of them related to me by the late Dr. John G. Sewall, vomiting occurred as an early symptom in 68 cases. Its absence on the first day was recorded in only 3 cases, while in the remaining 27 patients the records of the first day make no mention of its presence or absence. It was probably present in most of these 27 cases as one of the first symptoms.

Since the epidemic of 1872, in examining patients, now numbering thirty-six, as has been already stated, I have made careful inquiry in regard to the mode of commencement, and with only two or three exceptions either the previous health had been good, or, if symptoms of ill-health antedated the cerebro-spinal fever, they were due to some ailment entirely distinct from this disease. In a boy four and a half years of age, living in Broadway, it was stated to me that the cerebro-spinal fever came on gradually with pains in the head and elsewhere: this case was mild throughout and the patient was never in imminent danger. In nearly all the cases, if the patients were at home and under observation, the exact moment of the beginning of the disease could be stated. Thus, a man aged twenty-eight returned from his work at midday, April 23, 1883, in good health and cheerful, ate a hearty meal at twelve M., and at one P. M. had a chill, with intense headache and severe vomiting. Minute red points appeared on his face after vomiting, from capillary extravasations. In this case the interesting fact was observed of a cessation of the symptoms, so that on the 24th and 25th, being free from pain, he went to Brooklyn. On the 26th, however, the symptoms returned. He had pains in the head, back, and extremities, and was seriously sick. Occasional remissions, so that very grave symptoms become mild for a time and then return in full severity, as well as distinct intermissions, as in this case, have been frequently noticed by observers in different epidemics. A little girl, previously entirely well, was slightly punished on June 11, 1882; immediately she vomited and seemed quite sick; by kind nursing on the part of the mother she became better, so that on the 12th she had some appetite and went out. On the 13th cerebro-spinal fever began, with a temperature of 103° F., and its course was tedious. A robust girl, aged thirteen, vivacious and cheerful, went as usual in the morning to one of the public schools entirely well. Before the school was dismissed she returned home crying on account of dizziness and violent pain in the top of her head, in her knees, and in the calves of the legs. The case was attended by Prof. Alonzo Clark, Prof. Knapp, and myself, and was fatal after four and a half weeks. A boy aged ten returned from another public school in a similar manner, having gone to it in the morning in apparently perfect health.

We may therefore summarize as follows the symptoms which commonly attend the commencement of cerebro-spinal fever: violent pain in some part of the head, and sometimes also in the trunk or limbs, vomiting, a chill or chilliness, clonic convulsions, dizziness, dilated, sluggish, or altered pupils, fever of greater or less intensity according to the severity of the attack, heat of head, and in most patients heat of the surface generally. If the disease be of a severe and dangerous type, these symptoms are frequently followed within a few hours by delirium, semi-coma, or coma.

Nervous System.—Since in cerebro-spinal fever extensive and severe inflammation of the cerebral and spinal meninges occurs, with more or less congestion of the brain and spinal cord—lesions which we will consider hereafter—we should expect that this disease would be attended by severe and dangerous symptoms, inasmuch as the cerebro-spinal axis exerts such a controlling influence upon the functions of the body. Also we should expect that the symptoms would vary according to the portion of the meninges which happens to be most severely inflamed. There is, indeed, variation in symptoms according to the extent and intensity of the meningitis and the degree in which the cerebro-spinal axis is congested or implicated, but certain symptoms occur in all or nearly all cases, and as they are characteristic they render diagnosis easy.

Pain, already described as an initial symptom, continues during the acute period of the malady. It is ordinarily severe, eliciting moans from the sufferer, but its intensity varies in different patients. Its most frequent seat is the head, and the location of the cephalalgia varies in different patients and in the same patient at different times. One refers it to the top of the head, another to the occiput, and another to the frontal region, and the same patient at different times may complain of all these parts. The pain is described as sharp, lancinating, or boring. It is also common in the neck, especially in the nucha, the epigastrium, the umbilical and lumbar regions, along the spine (rachialgia), and in the extremities, where it shifts from one part to another. It is more common and persistent in the head and along the spine than elsewhere. The patient, if old enough to speak and not delirious or too stupid, often exclaims, "Oh my head!" from the intensity of his suffering, but after some moments complains equally of pain in some other part, while perhaps the headache has ceased or is milder. In a few instances the headache is absent or is slight and transient, while the pain is severe elsewhere. After some days the pain begins to abate, and by the close of the second week is much less pronounced than previously. Vertigo occurs with the headache, so that the patient reels in attempting to stand or walk. I have stated above that vertigo may be a prominent initial symptom, as in the girl of thirteen years who suddenly became sick in the public school which she was attending, and reached her home with difficulty on account of the headache and dizziness. Contributing to the unsteadiness of the muscular movements is a notable loss of flesh and strength, which occurs early and increases.

The state of the patient's mind is interesting. It is well expressed in ordinary cases by the term apathy or indifference, and between this mental state and coma on the one hand and acute delirium on the other there is every grade of mental disturbance. Some patients seem totally unconscious of the words or presence of those around them, when it subsequently appears that they understood what was said or done. Delirium is not infrequent, especially in the older children and in adults. Its form is various, most frequently quiet or passive, but occasionally maniacal, so that forcible restraint is required. It sometimes resembles intoxication or hysteria, or it may appear as a simple delusion in regard to certain subjects. Thus, one of my patients, a boy of five years, appeared for the most part rational, protruding his tongue when requested, and ordinarily answering questions correctly; but he constantly mistook his mother—who was always at his bedside—for another person. Severe active delirium is commonly preceded by intense headache. In favorable cases the delirium is usually short, but in the unfavorable it often continues with little abatement till coma supervenes.

On account of the pain and the disordered state of the mind patients seldom remain quiet in bed, unless they are comatose or the disease be mild or so far advanced that muscular movements are difficult from weakness. In severe cases they are ordinarily quiet for a few moments, as if slumbering, and then, aroused by the pain, they roll or toss from one part of the bed to another. One of my patients, a boy of five years, repeatedly made the entire circuit of the bed during the spells of restlessness. In mild cases or cases attended by less headache or mental disturbance patients are quiet, usually with their eyes closed unless when disturbed.

Hyperæsthesia of the surface is another common symptom. Few patients, not comatose, are free from it during the first weeks, and it materially increases the suffering. Friction upon the surface, and even slight pressure with the fingers upon certain parts, extort cries. Gently separating the eyelids for the purpose of inspecting the eyes, and moving the limbs or changing the position of the head, evidently increase the suffering and are resisted. I have sometimes heard such expressions of suffering from slowly introducing the thermometer into the rectum that I was led to believe that the anal and perhaps rectal surfaces were hypersensitive. The hyperæsthesia has diagnostic value, for there is no disease with which cerebro-spinal fever is likely to be confounded in which it is so great. It is due to the spinal meningitis, and is appreciable even in a state of semi-coma. The headache and hyperæsthesia fluctuate greatly in the course of the disease, and the former sometimes recurs at times, especially from mental excitement or from an afflux of blood to the brain from physical exertion, for months after the health is otherwise fully restored.

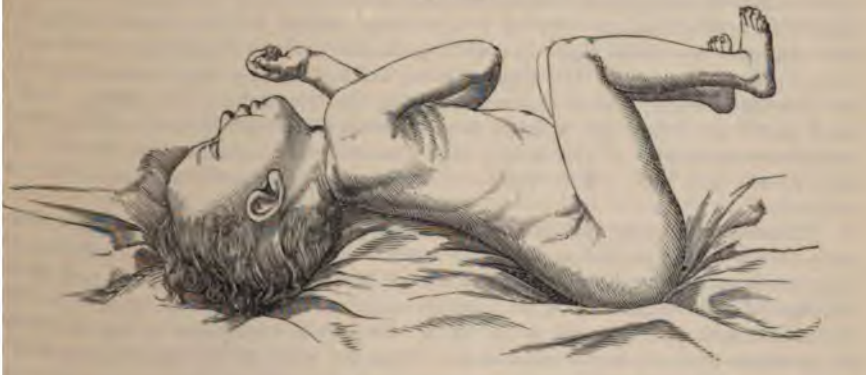
Some contraction of certain muscles or groups of muscles is present in all typical cases. In a small proportion of patients it is absent or is not a prominent symptom—to wit, in those in whom the encephalon is mainly involved, the spinal cord and meninges being but slightly affected or not at all. This contraction is most marked in the muscles of the nucha, causing retraction of the head, but it is also common in the posterior muscles of the trunk, causing opisthotonos, and in less degree in those of the abdomen and lower extremities, and hence the flexed position of the thighs and legs, in which patients obtain most relief. The muscular contraction is not an initial symptom. I have ordinarily first observed it about the close of the second day, but sometimes as early as the close of the first day, and in other instances not till the close of the third day. Attempts to overcome the rigidity, as by bringing forward the head, are very painful and cause the patient to resist. In young children having a mild form of the fever, with little retraction of the head, the rigidity is sometimes not easily detected. I have been able in such cases to satisfy myself and the friends of its presence by placing the child in an upright position, as on the lap of the mother, and observing the difficulty with which the head is brought forward on presenting to the patient a tumberful of cold water, which is craved on account of the thirst. The usual position of the patient in bed in a typical or marked case is with the head thrown back, the thighs and legs flexed, with or without forward arching of the spine. The muscular contraction and rigidity continue from three to five weeks, more or less, and abate gradually; occasionally they continue much longer. Through the kindness of Dr. Henry Griswold I was allowed to see an infant of seven months in the tenth week of the disease. It was still very fretful, and exhibited decided prominence of the anterior fontanel, probably from intracranial serous effusion, and marked rigidity of the muscles of the nucha, with retraction of the head.

Paralysis is another occasional symptom, but complete paralysis of any muscle or group of muscles is less frequent than one would suppose from the nature of the malady. It may occur early, but is sometimes a late symptom. It may be limited to one or two of the limbs, as the legs or an arm and a leg, or it may be more general. In a case occurring in Roosevelt Hospital and published in the *New York Medical Record* for October 10, 1878, the patient, a boy of ten years, was unable to move his legs one hour after the commencement of the disease. This sudden development of paraplegia in the commencement of cerebro-spinal fever resembled that of infantile paralysis, and was probably due to the same cause—to wit, active inflammatory congestion of the anterior cornua of the spinal column. The sudden and complete loss of speech which occurs in certain cases, when consciousness is retained and the vocal organs are in their normal state, seems to be due to the fact that the portion of the brain which controls the function of speech is acutely congested or is the seat of effusion. Thus, in June, 1882, a girl of three years whom I attended lost her speech on the second day of cerebro-spinal fever, and she was unable to articulate even the simplest word for two and a half months. Finally, she began to utter slowly and with difficulty the easiest monosyllables; and after the lapse of more than a year her speech was slow and lisping, her hands were tremulous and unsteady, she was easily fatigued, and cried often from oversensitiveness. During the long period of speechlessness she daily made efforts to talk, but without uttering a sound. Strabismus, to which we will allude hereafter in treating of the eye, is a common symptom, either transient or protracted, due to paralysis of certain of the motor muscles of the eye.

Paralysis of more or fewer muscles has been noticed and recorded by many observers in this country and in Europe. Dr. Law observed a patient in the epidemic of 1865 in Dublin who could move neither arms nor legs, and Wunderlich saw one who had paralysis of both lower extremities and of a considerable part of the trunk. As this symptom is due to the inflammatory process of the cerebro-spinal axis, it usually disappears in a few weeks as the inflammation abates and absorption of the inflammatory products occurs; but it may be more protracted. In Wunderlich's case there was only partial recovery from the paralysis after the lapse of five months.

Clonic convulsions have already been alluded to among the early symptoms of the attack. They indicate a grave form of the disease, and are

FIG. 30.



infrequent in young children, in whom they appear to occur in place the chill which is common in those of a more advanced age. The amptic attack may be short and not repeated, or it may be protracted, or turn again and again when the medicines which control it are suspended. nder such circumstances it is likely to end in profound coma, and is, of urse, a symptom of great gravity. Thus, an infant of seven months had nilateral eclamptic attacks daily during the first week of the attack. The other informed me that the convulsions seldom lasted longer than three inutes, and that the intervals between them were short. The child recovered with loss of sight from the cerebro-spinal fever, but still after the lapse of a year, when I examined him, had symptoms which were apparently due to hydrocephalus. Another infant of eleven months had clonic convulsions nearly constantly during the first twenty-four hours, but with occasional brief intermissions. On the following day he was in profound coma and apparently dying, with a temperature of 105° F. To my astonishment, he gradually emerged from the state of unconsciousness, and after a week was able to sit in his cradle long enough to take drinks.

Occasionally eclampsia does not occur in the first days, but in the second or third week, when it is usually accompanied by an increase of other symptoms, due to a recrudescence of the disease. A female infant aged eleven months, treated by me in 1882, had been sick one week when, during an increase in the febrile movement, she had one eclamptic seizure. Her recovery, though slow, was complete. A boy aged eleven and a half years, whose attack began with a chill, violent headache, and fever, and whom I visited frequently, died on the fourth day. Clonic convulsions did not occur in his case until within twenty-four hours of his death, when he had six seizures, which ended in coma.

Though adult patients are much less liable to eclampsia than children, they are not entirely exempt. A male patient aged twenty-eight years, whom I saw in consultation, had a single clonic convulsion lasting ten to fifteen minutes on the third day of his illness. In five weeks he had fully recovered, except that his headache returned upon any excitement. Even drinking a cup of beer caused it. Clonic convulsions are, however, much less common than the tonic muscular contraction and rigidity already alluded to. This occurs to a greater or less extent in nearly all cases, and is a symptom of diagnostic value, the rigidity often extending to the muscles of the extremities. Thus, in a child aged three years who had no eclampsia the tonic contraction of the muscles of the extremities did not relax till after the twelfth day.

Choreic or choreiform movements are occasionally observed. I do not refer to the tremulousness which sometimes occurs from weakness or as a premonition of eclampsia, but to a movement which has the character of true chorea. An infant aged ten months began to have choreic movements during the acute stage of the disease, most marked in the upper extremities and ceasing in sleep. They continued during the remainder of the life of the child, death occurring ten months subsequently from diphtheria. Rarely a choreiform movement of the eyes is also observed—a lateral movement from right to left and from left to right. I have seen from recollection two such cases.

Drowsiness, already spoken of, is a common symptom, and it exists in all grades from slight stupor to profound coma. In some patients it is present from the first hour, while in others it occurs after a period of restlessness or delirium or it alternates with it. Stupor more or less profound is common after the attack of eclampsia or the chill. That it is a frequent symptom in severe cases receives ready explanation from the state of the brain and its meninges, for the exudation which occurs upon the surface of the brain and the serous effusion within the ventricles are sufficient to cause it by compressing the cerebral substance. It is surprising in some cases how profound the stupor may be—a state, indeed, of coma, and yet the patient gradually emerges from it and recovers. In the epidemic of 1872, in New York City, when the malady was new with us, many physicians predicted certain death, and employed remedies without expectation of any benefit on account of the apparently hopeless state of patients, who seemed to be in profound coma, and yet not a few of them gradually and fully recovered.

Digestive System.—Vomiting, which is the most prominent symptom referable to the digestive system, has already been mentioned. Occurring early in the disease, it may cease in a few hours or not till after several days, and often it returns during the periods of recrudescence which are common in the progress of the fever. It occurs with little effort and without previous nausea or with little nausea, as is usual when it has a cerebral origin. It does not differ as a symptom from the vomiting which is so common in other forms of meningitis. The substance vomited consists of the ingesta and the secretions, as mucus and bile. Having a similar origin is a sensation of faintness or depression, referred to the epigastrium.

The appetite is usually impaired or lost during the active period of the attack, and it is not fully restored till convalescence is well advanced. Occasionally considerable nutriment is taken, and with apparent relish, as by one of my patients, twenty-eight years of age, who always had some appetite. Ordinarily, on account of repeated vomitings, constant febrile movements, impaired appetite and digestion, patients progressively lose flesh and strength, so that in protracted cases emaciation is always a prominent symptom, and is often extreme. Much emaciation and loss of strength, which attend many cases after the lapse of several weeks, greatly diminish the chances of a favorable termination. Thirst, already referred to, and constipation are common in this as in other forms of meningitis, but retraction of the abdomen is not a notable symptom, except in protracted and greatly-wasted cases. The diarrhœa which is occasionally present in cerebro-spinal fever in the summer months must be regarded as a distinct disease and a complication. The tongue and the buccal and faucial surfaces present nothing unusual in their appearance. It is seldom, even in the most protracted and emaciated cases, that the sordes and dry and brownish fur occur which are so common in typhus and typhoid fevers. The tongue is usually moist and but slightly furred.

I have seen in consultation two patients that perished early with inability to swallow as the prominent symptom, attended in both by an abundant secretion upon the faucial surface, without any redness, swelling, or other evidence of inflammation. The early death of these young children, whose ages were ten months and two years, rendered the diagnosis less certain than in most other patients, but the attending physician as well as myself diagnosticated cerebro-spinal fever with suddenly developed paralysis of the muscles of deglutition, so that no nutriment could be taken. If our understanding of these interesting cases is correct, the paralysis was caused by lesion of that portion of the medulla oblongata which controls the function of deglutition, or else by injury of the intracranial portions of the nerves which supply the muscles concerned in this act. The following were the cases in question:

O——, male, two years of age, became feverish and dull, but without vomiting, on October 22, 1882; axillary temperature, 102° F. On the following day inability to swallow occurred, and the muscles of deglutition appeared totally inactive. Death occurred on the third day, suddenly and apparently easily, as if from arrested function of important nerves, especially the pneumogastric. The abundant secretion of thin mucus or transudation of serum covering the faucial surface, and reaccumulating as soon as removed without any notable change in the appearance of the fauces, was remarkable. The physician in attendance, who for more than thirty years had had a large city practice, had seen no similar case, nor had I at the time.

Soon afterward the second case occurred. An infant of ten months, without cough or embarrassment of respiration or faucial redness or swelling, lost the power of deglutition soon after the commencement of the supposed cerebro-spinal fever, so that in the attempts to swallow the drinks entered the larynx, and the secretion or exudation was abundant, as in the other case. Death occurred in forty-eight hours. The rectal temperature was only 101° F.

In another case, which was ultimately fatal and in which the diagnosis of cerebro-spinal fever was certain, a robust girl, aged twelve, suddenly lost the power of deglutition at one time during her sickness, although she was entirely conscious and repeatedly endeavored to swallow. The ability to swallow returned in a few days.

Pulse.—This is usually accelerated, and the more severe and dangerous the attack the more rapid is the heart's action, except occasionally in the comatose state, when, probably in consequence of compression of the brain from an abundant exudation, the pulse may be subnormal. Thus, in one of my patients, an adult, the pulse fell to 40 per minute, and in two others to between 60 and 70 per minute. With the exception of these three, the pulse in all cases which I have observed, so far as I recollect, has varied from the normal number of beats per minute to such frequency that it was difficult to count it. As death draws near the pulse ordinarily becomes more frequent and feeble. Intermissions in the pulse do not seem to be as common as in other forms of meningitis, but marked variations in its frequency during different hours of the day and on consecutive days constitute a conspicuous symptom. Thus, in a case which was fatal in the fifth week consecutive enumerations of the pulse in the acute stage were as follows: 128, 120, 88, 130, 84, 112.

Temperature.—Some of the older writers before the days of clinical thermometry stated that the temperature is not increased. North remarked as follows: "Cases occur, it is true, in which the temperature is increased above the natural standard, but these are rare;" and Foot and Gallop make similar statements. Some recent writers have held the same opinion. Thus, Lidell wrote as follows in a treatise bearing the date of 1873: "Febrile symptoms do not necessarily belong to epidemic cerebro-spinal meningitis as a substantive disease, for it may, and not unfrequently does, occur without exhibiting any such symptoms." We should naturally expect that meningitis, accompanied as it is by active congestion of the brain and spinal cord, would produce more or less fever, and in eighty-six cases which I examined by the thermometer I found elevation of temperature in every case during the acute stage, except in the beginning of the attack in two instances. In a young man aged twenty-eight years who had severe headache and seemed seriously sick the thermometer under the tongue showed no rise of temperature on the first and second days, but on the third day it was at 100° F., and it remained elevated till his death on the thirteenth day. The second case was that of a young woman whom I saw in consultation, and who at the time of my visit had fever, but had had none previously, according to the statement of the attending physician.

In the 87 cases which I examined the heat of the surface occasionally did not seem above normal to the touch, and now and then the thermometer, applied in the axilla or groin, did not indicate fever, but the rectal temperature was always elevated above that of health after the disease was fully established. The temperature fluctuated from day to day and in different hours of the same day, but there was no exception to the rule that it was above the normal during the active stage of the malady after the first few days. Sometimes the elevation of temperature was slight, as in a female patient forty-seven years of age, in whom the thermometer showed no elevation of temperature when it was placed in the mouth and axilla, but on introducing it into the rectum it rose to to 99½° F. In the case of a young lady attended by me in 1890, having a very asthenic and fatal form of cerebro-spinal fever, accompanied by great prostration, a brown and dry tongue, and delirium, the temperature under the tongue was subnormal during the first two or three days, but was afterward above normal.

The highest temperature which I have thus far observed was 107⅗° F., in a child aged two years. This was in the commencement of the attack. Subsequently it fell a little, but rose again on the third day to 107°, when she died. In two other cases the temperature was 106° F. on the first day, and it did not afterward reach so high an elevation. One of these died on the ninth day, and the other in the ninth week. The next highest temperature was 105⅘° F., also on the first day, in an infant aged eight months, who died on the ninth day. The first and last of these cases occurred in an old wooden tenement-house in the suburbs of the city and upon an elevated outcropping of rock. The highest temperature in any case in New York City which has come to my notice was observed in a male patient aged twenty-eight years who had active delirium, and died on the fifth day in Roosevelt Hospital. The temperature on the last day, taken four times, was as follows: 102½°, 106¾°, and, when the pulse had become imperceptible, 109° and 107¾° F. Wunderlich has recorded a temperature of 110° F. in one or two cases, but so great an elevation must be very rare, and is of course prognostic of an unfavorable ending.

The external temperature undergoes still greater fluctuations than the internal, rising above and falling below the normal standard several times in the course of the same day. Similar fluctuations occur in other forms of meningitis, but they are, according to my experience, less pronounced than in cerebro-spinal fever, especially as I observed them in the epidemic of 1872. Perhaps since that epidemic they have been less marked in the cases occurring in this city. The more grave the attack in those not comatose the greater these variations. The following is a common example of these sudden thermometric changes, occurring in a child of two years. The internal temperature varied from 101° to 104⅘° F. as the extremes, while that of the fingers and hands at the first examination was 90½°, at the second 90°, at the third 103°, and at the fourth 83°. Hence at the third examination the temperature of the extremities had risen 13°, so as nearly to equal that of the blood, and at the fourth examination it had fallen 20°. The patient recovered. These great and sudden variations in the pulse and the internal and external temperature have considerable diagnostic value in obscure and doubtful cases.

Respiratory System.—This system is not notably involved in ordinary cases. Intermittent, sighing, or irregular respiration appears to be less frequent than in tubercular meningitis, but it does occur. In most patients the respiration is quiet, but somewhat accelerated, and without any marked disturbance in its rhythm. In thirty-one observations in children who had no complication, I found the average respirations 42 per minute, while the average pulse was 137. Therefore the respiration, as compared with the pulse, was proportionately more frequent than in health, due perhaps to the fact that certain muscles concerned in respiration, as the abdominal, are embarrassed in their movements by tonic contraction.

Various observers in different epidemics have recorded an unusual prevalence of croupous pneumonia occurring simultaneously with cerebro-spinal fever. Bascome in his history of epidemics stated that "epidemic encephalitis and malignant pneumonias prevailed in Germany in the sixteenth century" (Webber). Webber in his prize essay describes a variety of cerebro-spinal fever which he designates pneumonic, in which the cerebro-spinal axis is involved but slightly or not at all, and the brunt of the disease falls upon the respiratory organs. According to him, in certain epidemics the pneumonic form has been common and in others infrequent. This fact is interesting taken in connection with the examination of the microbes of croupous pneumonia and cerebro-spinal fever, as detailed in our remarks under the head of etiology.

Cutaneous Surface.—The features may be pallid, of normal appearance, or flushed in the first days of the disease, but in advanced cases they are pallid, as is the skin generally. A circumscribed patch of deep congestion often appears, as in sporadic meningitis, upon some part of them, as the forehead, cheek, or an ear, and after a short time disappears. The hyperæmic streak, the *tache cérébrale* of Trousseau, produced by drawing the finger firmly across the surface, also appears as in other forms of meningitis if the temperature of the surface be not too much reduced.

The following are the abnormal appearances of the skin most frequently observed: 1. Papilliform elevations, the so-called goose-skin, due to contractions of the muscular fibres of the corium. This is not uncommon in the first weeks. 2. A dusky mottling, also common in the first and second weeks in grave cases, and most marked when the temperature is reduced. 3. Numerous minute red points over a large part of the surface, bluish spots a few lines in diameter, due to extravasation of blood under the cuticle, resembling bruises in appearance, and large patches of the same color an inch or more in diameter, less common than the others, of irregular shape as well as size, and usually not more than two or three upon a patient. These last resemble bruises, and they may sometimes be such, received during the times of restlessness; but ordinarily extravasations of this kind result entirely from the altered state of the blood. In New York in the epidemic of 1872 they were common, but since this epidemic, in the thirty-six cases which I have observed, I have rarely seen either the reddish points or the extravasations of blood. They were probably common in the epidemics in the first part of this century in this country, since the disease was designated by the name "spotted fever" by the American physicians who wrote upon it at that time. That they are unusual in the European epidemics at the present time we infer from the fact that Von Ziemssen expresses surprise that the disease should ever have been designated in America by such a title. 4. Herpes. This is common. It sometimes occurs as early as the second or third day, but in other instances not till toward the close of the first week or in the second. The number of herpetic eruptions varies from six or eight to clusters as large as or larger than the hand. This cutaneous disease evidently has a nervous origin, its vesicles occurring in most instances on those parts of the surface which are supplied by branches of the fifth pair of nerves. Its most common seat is upon the lips, but occasionally it appears upon the cheek, upon and around the ears, and upon the scalp. Erythema and roseola, both transient skin eruptions, occasionally appear, and in one instance in my practice erysipelas occurred. During the first days the skin is frequently dry; afterward perspirations are not unusual, and free perspirations sometimes occur, especially about the head, face, and neck.

Urinary Organs.—In other forms of meningitis it is well known that the quantity of urine excreted is usually diminished, but in this disease it is normal, and it may be more than normal. Polyuria has been noticed in different cases by various observers. Mosler observed a boy aged seven years who had an excessive secretion of urine, which dated back to an attack of cerebro-spinal fever in his third year. The polyuria is probably due to injury of the nervous centre, since physiological experiment has demonstrated that irritation of the central end of the vagus, of certain parts of the cerebellum, and of the walls of the fourth ventricle sometimes produces this effect. The urine occasionally contains a moderate amount of albumen, and in exceptional instances cylindrical casts and blood-corpuscles.

Arthritic inflammation, apparently of a rheumatic character, has been occasionally observed. It is commonly slight, producing merely an œdematous appearance around one or more joints. Thus in one case which came under my notice, and which was subsequently fatal, the parents, who were poor, and were therefore without medical advice till the case was somewhat advanced, had already diagnosticated rheumatism on account of the puffiness which they had noticed around one of the wrists.

The Special Senses.—Taste and smell are rarely affected, so far as is known, but it is possible that they are sometimes perverted, or even temporarily lost, during the time of greatest stupor. In one case which I saw the sense of smell was entirely lost in one nostril, and I do not know whether it was ever fully restored.

The affections of the eye and ear are important and of frequent occurrence. Strabismus is common. It may occur at any period of the fever, continuing a few hours or several days, and it may appear and disappear several times before convalescence is established: occasionally it continues several weeks, after which the parallelism of the eyes is gradually and fully restored. In other instances it is permanent.

Changes in the pupils are among the first and most noticeable of the initial symptoms, as I have already stated in describing the mode of commencement. These are dilatation, less frequently contraction, oscillation, inequality of size, feeble response to light, etc. Most patients present one or more of these abnormalities of the pupils, and they continue during the first and second weeks, and gradually abate if the course of the disease be favorable. Inflammatory hyperæmia of the conjunctiva often occurs. It begins early, and now and then the conjunctivitis is so intense that considerable tumefaction of the lids results, with a free muco-purulent secretion. The false diagnosis has indeed been made of purulent ophthalmia in cases in which this affection of the lids was early and severe. But such intense inflammation is quite exceptional. More frequently there is a uniform diffused redness of the conjunctiva, not so dusky as in typhus, and the injected vessels cannot be so readily distinguished as in that disease.

In certain cases almost the whole eye (all, indeed, of the important constituents) becomes inflamed; the media grow cloudy, the iris discolored, and the pupils uneven and filled up with fibrinous exudation. The deep structures of the eye cannot, therefore, be readily explored by the ophthalmoscope, but they are observed to be adherent to each other and covered by inflammatory exudation. They present a dusky-red or even a dark color when the inflammation is recent. Exceptionally the cornea ulcerates and the eye bursts, with the loss of more or less of the liquids and shrinking of the eye. "But ordinarily no ulceration occurs, and as the patient convalesces the œdema of the lids, the hyperæmia of the conjunctiva, the cloudiness of the cornea and of the humors gradually abate and the exudation in the pupils is absorbed. The iris bulges forward, and the deep tissues of the eye, viewed through the vitreous humor, which before had a dusky-red color from hyperæmia, now present a dull-white color." The lens itself, at first transparent, after a while becomes cataractous. Sight is lost totally and for ever.

If the patient live, the volume of the eye diminishes, as the inflammation abates, to less than the normal size, even when there has been no rupture and escape of the fluids, and divergent strabismus is likely to occur. Prof. Knapp, whose description of the eye I have for the most part followed, says: "The nature of the eye affection is a purulent choroiditis, probably metastatic." Fortunately, so general and destructive an inflammation of the eye as has been described above is comparatively rare. On the other hand, conjunctivitis of greater or less severity, and hyperæmia of the optic disc, consequent upon the brain disease, are not unusual, but they subside, leaving the function of the organ unimpaired. "In some cases incurable blindness is noticed under the ophthalmoscope picture of optic nerve-atrophy, probably the sequence of choked disc" (Knapp).

Inflammation of the middle ear, of a mild grade and subsiding without impairment of hearing, is common. The membrana tympani during its continuance presents a dull-yellowish, and in places a reddish, hue. Occasionally a more severe otitis media occurs, ending in suppuration, perforation of the membrana tympani, and otorrhœa, which ceases after a variable time. But otitis media is not the most severe of the affections of the organs of hearing. Certain patients lose their hearing entirely, and never regain it, and that, too, with little otalgia, otorrhœa, or other local symptoms by which so grave a result can be prognosticated. This loss of hearing does not occur at the same period of the disease in all cases. Some of those who become deaf are able to hear as they emerge from the stupor of the disease, but lose this function during convalescence, while the majority are observed to be deaf as soon as the stupor abates and full consciousness returns.

Two important facts have been observed in reference to the loss of hearing in these patients—to wit, it is bilateral and complete. When first observed it is in some, as stated above, complete, but in others partial, and when partial it gradually increases till after some days or weeks, when it becomes complete. I have the records of 10 cases of this loss of hearing, most of them occurring in my own practice in the epidemic of 1872, but a few or them detailed to me by the physicians who observed them in the same epidemic. According to these statistics, about 1 in every 10 patients became deaf, but in the milder form of cerebro-spinal meningitis which has prevailed since 1872 the proportionate number thus affected has been less among my patients, and the same may be said in reference to the loss of sight: 1 of the 10 cases was a young lady, but the rest were children under the age of ten years. Prof. Knapp has examined 31 cases. "In all," says he, "the deafness was bilateral, and, with 2 exceptions of faint perceptions of sound, complete. Among the 29 cases of total deafness there is only 1 who seemed to give some evidence of hearing afterward." The same author has recently informed me that further experience has confirmed his previous statement, that while the blindness produced by cerebro-spinal fever is in the majority of cases monolateral, but one case had come to his notice in which the deafness was on one side only.

One theory attributes the loss of hearing to inflammatory lesions either at the centre of audition within the brain, or in the course of the auditory nerves before they enter the auditory foramina. The other theory, which is the better established of the two and must be accepted, attributes the loss of hearing to inflammatory disease of the ear, and especially of the labyrinth.

SYMPTOMS OF ENDEMIC OR NATURALIZED CEREBRO-SPINAL FEVER.—The numerous monographs on this disease which have appeared during the last few years relate to its epidemic form, and no published observations, so far as I am aware, describe the character or symptoms which it presents or the changes which it undergoes when it occurs as an endemic or naturalized disease. The endemic disease must, of course, be observed in the cities or populous towns, for there is no rural locality, so far as I am aware, in which this disease is permanently established. In New York the naturalized disease appears to be accompanied by a less profound blood-change than occurs in epidemic cases. Although every year seeing a considerable number of cases, I have not in the last ten years seen one with the livid spots upon the surface, due to subcutaneous extravasation of blood, which were so common in the epidemic of 1872, and which have been so common in epidemics both in this country and in Europe that the term "spotted fever" was applied to the malady. Occasionally petechiæ occur in severe cases of the naturalized disease.

Nature.—The theory that cerebro-spinal fever is a local disease, occurring epidemically, was commonly held in the first part of this century, but is now discarded. Job Wilson in 1815 considered it a form of influenza, and could see no utility in drawing a distinction between spotted fever and influenza. We at the present time can see no resemblance between the two, except that both occur as epidemics. The theory that cerebro-spinal fever is a peculiar local disease occurring in epidemics is more plausible than that which holds that it is a form of influenza. Even Niemeyer says that it presents no symptoms except such as are referable to the local affection. But the evidence is strong that cerebro-spinal fever is a constitutional malady with the meningitis as a local manifestation, just like measles with its bronchitis or scarlet fever with its pharyngitis. The abrupt and severe commencement, unlike that of those forms of meningitis which are known to be strictly local, and the early blood-change, as shown in certain cases by the appearance of the skin and extravasation under it, indicate a general disease. Constitutional diseases having prominent local symptoms and lesions are usually regarded at first as local. It is only as time goes on and they are more thoroughly studied and understood, and clinical observations multiply, that their constitutional nature is recognized.

The theory that cerebro-spinal fever is a form of typhus once had advocates, but it is now so generally discarded as untenable and absurd that it would be a waste of time to consider the facts which differentiate the two maladies. Cerebro-spinal fever should therefore be considered as distinct from all other diseases, a malady *sui generis*, and in nosological writings it should be classified with those constitutional maladies which have specific causes.

Although this disease ordinarily occurs in an epidemic form in localities widely separated from one another, and, after continuing a few weeks or months, totally disappears, perhaps never to return or not till after the lapse of years, nevertheless in localities it becomes established, so that it is proper to describe it as an endemic—a fact to which we have already referred as regards certain American cities. I do not know that it is endemic in any village or rural locality in this country. The large cities, with their promiscuous population, foreign and native, their crowded tenement-houses, and their many sources of insalubrity, furnish in an eminent degree the conditions which are favorable for the development and perpetuation of the microbic diseases. Those diseases which in the present state of our knowledge we have reason to believe are caused by micro-organisms we should expect to prevail most where domiciles are crowded and filthy and systems are enervated by impure air, hardships, and privation. Hence in New York City, in the crowded quarters of the poor, cerebro-spinal fever, like diphtheria, is seldom or never absent.

Deaths in New York from Cerebro-Spinal Fever.

	Number.		Number.
1872	782	1880	170
1873	290	1881	461
1874	158	1882	238
1875	146	1883	223
1876	127	1884	210
1877	116	1885	202
1878	97	1886	223
1879	108	1887	203

It is seen that the greatest mortality was in the first year after the introduction of the disease into the city, after which the number of deaths gradually diminished, year by year, till 1878, when the lowest mortality was reached. After 1878 the mortality gradually increased till 1881, in which year the number of deaths was double that of any other year except 1872.

The mortuary reports of Philadelphia likewise show that cerebro-spinal fever has remained in that city since its introduction in 1863, a period of twenty-five years, the annual deaths produced by it varying between 36, the minimum, in 1869 and 1870, and 384, the maximum, in 1864. In Providence also, as appears from Dr. Snow's reports, cerebro-spinal fever has caused annually more or fewer deaths since 1871. Therefore, we repeat, this fact may be added to the sum of our knowledge of this disease, that once gaining a lodgment where the conditions are favorable for it, as in a large city, it may become established and remain an indefinite time.

ANATOMICAL CHARACTERS.—I have notes of the post-mortem appearances in 76 cases, published chiefly in British and American journals: 29 died within the first three days, 28 between the third and twenty-first days, and the duration of the remaining 19 was unknown. These records furnish the data for the following remarks.

The blood undergoes changes which are due in part to the inflammatory and in part to the constitutional and asthenic nature of the disease. The proportion of fibrin is increased in cases that are not speedily fatal, as it ordinarily is in idiopathic inflammations. Analyses of the blood by Ames, Tourdes, and Maillot show a variable proportion of fibrin from three and four-tenths to more than six parts in one thousand. In sthenic cases accompanied by a pretty general meningitis, cerebral and spinal, there is, after the fever has continued some days, the maximum amount of fibrin, while in the asthenic and suddenly fatal cases, with inflammation slight or in its commencement, the fibrin is but little increased. The most common abnormal appearance of the blood observed at autopsies is a dark color with unusual fluidity and the presence of dark soft clots. Exceptionally bubbles of gas have been observed in the large vessels and the cavities of the heart. An unusually dark color of the blood, small and soft dark clots, and the presence of gas-bubbles when only a few hours have elapsed after death indicate a malignant form of the disease, in which the blood is early and profoundly altered. In certain cases this fluid is not so changed as to attract attention from its appearance. The points or patches of extravasated blood which are observed in and under the skin during life in some patients usually remain in the cadaver. When an incision is made through them the blood is seen to have been extravasated, not only in the layers of the skin, but also in the subcutaneous connective tissue. Extravasations of small extent are likewise sometimes observed upon and in thoracic and abdominal organs.

In those who die after a sickness of a few hours or days—namely, in the stage of acute inflammatory congestion—the cranial sinuses are found engorged with blood and containing soft dark clots. The meninges enveloping the brain are also intensely hyperæmic in their entire extent in most cadavers, but in some cases the hyperæmia is limited to a portion of the meninges, while other portions appear nearly normal. In those cases which end fatally within a few hours this hyperæmia is ordinarily the only lesion of the meninges; but if the case be more protracted serum and fibrin are soon exuded from the vessels into the meshes of the pia mater, and underneath this membrane over the surface of the brain. Pus-cells also occur mixed with the fibrin, sometimes so few that they are discovered only with the microscope, but in other cases in such quantity as to be much in excess of the fibrin and to be readily detected by the naked eye. Pus, which in these cases probably consists of white blood-corpuscles which have escaped with the fibrin from the meningeal vessels. often appears early in the attack. The arachnoid soon loses its transparency and polish, and presents a cloudy appearance over a greater or less extent of its surface. This cloudiness is usually greatest along the course of the vessels in the sulci and depressions and where the fibrinous exudation is greatest, but it occurs also in places where no such exudation is apparent to the naked eye.

The exudation—serous, fibrinous, and purulent—occurs, as in other forms of meningitis, within the meshes of the pia mater, and underneath this membrane over the surface of the brain. The fibrin is raised from the surface of the brain with the meninges in making the autopsy. It is most abundant in the intergyral spaces, around the course of the vessels, over and around the optic commissure, pons Varolii, cerebellum, and medulla oblongata, and along the Sylvian fissures. It is most abundant in the depressions, where it sometimes has the thickness of one-tenth to one-fourth of an inch, but it often extends over the convolutions so as to conceal them from view.

Most other forms of meningitis have a local cause, and are therefore limited to a small extent of the meninges—as, for example, meningitis from tubercles or caries of the petrous portion of the temporal bone, in both of which it is commonly limited to the base of the brain; or from accidents, when the meningitis commonly occurs upon the side or summit of the brain. The meningitis of cerebro-spinal fever, on the other hand, having a general or constitutional cause, occurs with nearly equal frequency upon all parts of the meningeal surface, except that it is perhaps most severe in the depressions, where the vascular supply is greatest. In cases of great severity the inflammatory exudation, fibrinous or purulent, or both, covers nearly or quite the entire surface of the brain.

In those who die at an early stage of the attack the vessels of the brain, like those of the meninges, are hyperæmic, so that numerous "puncta vasculosa" appear upon its incised surface. At a later period this hyperæmia, like that of the meninges, may disappear. If there be much effusion of serum within the ventricles and over the surface of the brain, the convolutions are liable to be flattened, and the pressure may be so great that the amount of blood circulating in the brain is reduced below the normal quantity. Thus, in the case of a child of three years who lived sixteen days, and was examined after death by Burdon-Sanderson, the ventricles contained a large amount of turbid serum and the brain-substance was everywhere pale and anæmic from compression.

Cerebral *ramollissement* occurs in certain cases. At one of the examinations in Charity Hospital, the patient having been only three days sick, the brain was found much softened. The dissection was made seven hours after death, so that the softening could not have been the result of decomposition. At one of the post-mortem examinations in Bellevue Hospital softening of the fornix, corpus callosum, and septum lucidum was observed, and in another softening in the neighborhood of the subarachnoid space. In a case related by Dr. Moorman[1] it is stated that portions of the brain, medulla oblongata, and pons Varolii were softened. In a case observed by Dr. Upham softening of the superior portion of the left cerebral hemisphere had occurred. Occasionally the whole brain is somewhat softened. Burdon-Sanderson, Russell, and Githens each relate such a case. Moreover, the walls of the lateral ventricles are ordinarily more or less softened in fatal cases of cerebro-spinal fever, as they are in other forms of meningitis. In rare instances the brain is œdematous, as in a case published by Dr. Hutchinson.[2] In this case the patient was only four days sick and the whole brain was œdematous, serum escaping from its incised surface.

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[1] *American Journal of the Medical Sciences*, October, 1866.

[2] *Ibid.*, July, 1866.

The ventricles contain liquid, in some patients transparent serum, in others serum turbid and containing flocculi of fibrin or fibrin with pus. The liquids in the different ventricles, since they intercommunicate, are the same. The choroid plexus is either injected or it is infiltrated with fibrin and pus. With the abatement of the inflammation absorption commences. The serum, from its nature, is readily absorbed, and the pus and fibrin more slowly by fatty degeneration and liquefaction. Occasionally the serum remains, and chronic hydrocephalus results. An infant who contracted the disease at the age of five months, and appeared to be convalescent, had, two months subsequently, great prominence of the anterior fontanel, and other symptoms indicating the presence of a considerable amount of effusion within the cranium. In another case, one year afterward, examination showed the enlargement of the head and prominence of the fontanel which characterize chronic hydrocephalus. A boy of ten years treated in Roosevelt Hospital in 1878 died three months after the commencement of cerebro-spinal fever. The records of the autopsy state: "Body a skeleton; brain, dura mater, and pia mater appear normal, except a little thickening of latter at base of brain; ventricles much enlarged and full of clear serum; surface of walls of ventricles appears normal, but is soft; spinal cord and membranes apparently normal; heart, lungs, stomach, and intestines normal; liver congested; kidneys pale." In this case, therefore, all the other lesions of the cerebro-spinal axis, except the serous effusion, had nearly disappeared. No post-mortem examinations, so far as I am aware, have yet revealed the state of the brain and its meninges in those who have had this malady at some former time and have fully recovered, whether there may not be some traces of it which are permanent, as opacity or adhesions.

The remarks made in reference to the cerebral apply, for the most part, also to to the spinal meninges. There is at first intense hyperæmia of the membranes, usually over the entire surface of the cord, soon followed by fibrinous, purulent, and serous exudation in the meshes of the pia mater and underneath this membrane. This exudation is sometimes confined to a portion of the meninges, more frequently that covering the posterior than the anterior aspect of the cord, and when it is general it is ordinarily thicker posteriorly than anteriorly. In severe cases nearly or quite the entire spinal pia mater may be infiltrated by inflammatory products. Thus, in the case of an infant that died of cerebro-spinal fever at the age of ten weeks, in the service of Dr. H. D. Chapin, in the Out-door Department at Bellevue, the entire spinal cord was covered by a fibrino-purulent exudation, except a space about six lines in extent upon the anterior surface.

No constant or uniform lesions occur in the organs of the trunk, and those observed are not distinctive of this disease. Hypostatic congestion of the lungs, bronchitis, atelectasis, and broncho-pneumonia are common. Pleuritic, endocardial, and pericardial inflammations have occasionally been observed, but are rare. Effusion of serum, sometimes blood-stained, occasionally occurs in the pleural and other serous cavities. The auricles and ventricles of the heart, as already stated, contain more or less blood, with soft dark clots in the more malignant and rapidly fatal cases, but larger and firmer in those which have been more protracted. The spleen is enlarged in less than half the patients. The absence of uniformity as regards the state of the spleen, the fact that in many it undergoes no appreciable change, is important, since this organ is so generally enlarged and softened in the infectious diseases. The stomach, intestines, and liver are sometimes more or less congested, but in other cases their appearance is normal. The agminate and solitary glands of the intestines have ordinarily been overlooked, but in certain cases they have been found prominent. The kidneys are normal, or they exhibit the lesions of nephritis. In 1 of 8 autopsies made by Prof. Welch acute diffuse nephritis had been present, as shown by the state of the kidneys. In the case of a child of nine years treated by Dr. F. A. Burrall in the Presbyterian Hospital the urine was very albuminous and the kidneys presented a fatty appearance. Anatomical changes in these organs, however, are not common, unless in slight degree, so that in most patients their function is fully and properly performed.

PROGNOSIS.—Cerebro-spinal fever is justly regarded as one of the most dangerous maladies of childhood. It is dreaded not only on account of the great mortality which attends it, but also on account of its protracted course, the suffering which it causes, the possible permanent injury of the important organ which is chiefly involved, and the not infrequent irreparable damage which the eye and ear sustain.

I have the records of the result in 52 cases which I attended or saw in consultation in the epidemic of 1872. Of these just one-half recovered. 16 of the 26 who died were hopelessly comatose within the first seven days, most of them dying within that time, and some even on the first and second days, while others of the 16 lingered into the second week and died without any sign of returning consciousness. The remaining 10, who subsequently died, but did not become comatose in the first week, were nevertheless seriously sick from the first day, but their symptoms, though severe, were not such as necessarily indicated a fatal result, so that there was some expectation of a favorable ending till near death, which occurred for the most part from asthenia. One succumbed to purpura hæmorrhagica, the hemorrhages occurring from the mucous surfaces. The patient died after a sickness of more than two months, in a state of extreme emaciation and prostration. The 26 who recovered convalesced slowly, and usually after many fluctuations. Their highest temperature and most severe and dangerous symptoms occurred in the first week. Most of them were several weeks under observation and treatment before they sufficiently recovered to be out of danger. The statistics of this epidemic therefore show—and the same is true of other epidemics—that the first week is the time of greatest danger, and if no fatal symptoms are developed during this week recovery is probable with proper therapeutic measures and kind, intelligent, and efficient nursing, which is very important.

Since 1872 I have seen a larger number, but have preserved records of 40 cases which I was able to follow to the close. Some were seen in consultation. Of these 40, 21 recovered and 19 died. Of the 19 fatal cases, 9 died in the first week, 5 in the second week, 1 in the third week, 1 on the twenty-fifth day, 1 on the thirty-first day, and 1 in the sixteenth week. This last patient, a boy of ten years, would, in my opinion, have recovered with better nursing. His death occurred from large bed-sores which extended to the bones, produced by lying a long time in one position on a hard bed when he was too weak to move, and often with soiled bedclothes underneath him. The remaining case of the 19 died after a prolonged sickness.

There is probably no disease which falsifies the predictions of the physician more frequently than cerebro-spinal fever. This is due partly to the severity of the cerebral symptoms in the commencement, which, did they occur in other forms of meningitis with which he is more familiar, would justify an unfavorable prognosis, and partly to the remissions and exacerbations, the occurrence alternately of symptoms of apparent convalescence and recrudescence or relapse which characterize the course of this malady. Grave initial symptoms, which may appear to have a fatal augury, are often followed by such a remission that all danger seems past, and in a few hours later perhaps the symptoms are nearly or quite as grave as at first.

Under the age of five years and over that of thirty the prognosis is less favorable than between these ages. An abrupt and violent commencement, profound stupor, convulsions, active delirium, and great elevation of temperature are symptoms which should excite solicitude and render the prognosis guarded. If the temperature remain above 105° F., death is probable, even with moderate stupor. Numerous and large petechial eruptions show a profoundly altered state of the blood, and are therefore a bad prognostic; and so is continued albuminuria, since it shows great blood-change or nephritis, while other organs than the kidneys are probably also involved. In one case, a boy whom I examined nearly a year after the cerebro-spinal fever, the kidneys were still affected. He had anasarca of the face and extremities, with albuminuria. Chronic Bright's disease had occurred from the acute nephritis which complicated cerebro-spinal fever. Profound stupor, though a dangerous symptom, is not necessarily fatal so long as the patient can be aroused to partial consciousness and the pupils are responsive to light; so long as it does not pass into actual coma it is less dangerous than active or maniacal delirium, which is likely to eventuate in this coma.

A mild commencement with general mildness of symptoms, as the ability to comprehend and answer questions, moderate pain and muscular rigidity, some appetite, moderate emaciation, little vomiting, etc., justify a favorable prognosis, but even in such cases it should be guarded till convalescence is fully established.

We may repeat and emphasize the important fact shown by the above statistics that patients who live till the close of the second week without serious complications will probably recover. The danger after this period is, in most instances, from exhaustion and feeble action of the heart, resulting from the impaired nutrition and the protracted course of the disease.

Complications which most frequently pertain to the lungs increase greatly the gravity of many cases and contribute to the fatal ending. The fact that Webber in his prize essay describes a variety of cerebro-spinal fever which he designates pneumonic, and that those who make post-mortem examinations find that "œdema, hypostatic congestion of the lungs, bronchitis, atelectasis, and broncho-pneumonia are extremely common lesions in cerebro-spinal meningitis" (Welch), indicate a source of danger in addition to that located in the cerebro-spinal system. One close observer of an epidemic writes: "In all the fatal cases which came under my notice the most prominent symptoms which preceded death were those which indicate impairment and perversion of the respiratory functions. As the breathing became more hurried and difficult the general depression became more intense, the pulse became weaker and quicker, and the temperature of the skin more elevated."

Parenchymatous degeneration of the liver and kidneys is another serious complication. The kidneys are probably more frequently, and to a greater extent, diseased than the liver. We have already stated that nephritis was present in 1 of the 8 cases examined by Prof. Welch. In the *Revue médicale* for June 3, 1882, M. Ernest Gandier published the case of a female who died comatose on the sixth day of cerebro-spinal fever. Examination of the urine had revealed the presence of "retractile albumen of Prof. Bouchard, attributable to renal lesions, and non-retractile albumen, considered as an indication of some general infection of the system." Microscopic examination of the kidneys "showed considerable swelling and granular degeneration of the renal epithelial cells, with effusion of granular matter within the lumina of the tubules." We have seen from the case referred to above that the renal complication may persist and become chronic. Those who fully recover often exhibit symptoms usually of a nervous character, as irritability of disposition, headache, etc., for months or years after convalescence is established.

DIAGNOSIS.—Cerebro-spinal fever, on account of the nature and severity of its symptoms and the suddenness of its onset, may be mistaken for scarlet fever, and *vice versâ*. In one instance, to my knowledge, this mistake was made. High febrile movement, vomiting, convulsions, and stupor are common in the commencement of scarlet fever, and the same symptoms commonly usher in the severer forms of cerebro-spinal fever. It will aid in diagnosis to ascertain whether there be redness of the fauces, for this is present in the commencement of scarlet fever, and a few hours later the characteristic efflorescence appears on the skin.

The diagnosis of cerebro-spinal fever from the common forms of meningitis is ordinarily not difficult, for while in the former the maximum intensity of symptoms occurs in the first days, in the latter there is gradual and progressive increase of symptoms from a comparatively mild commencement. Moreover, cases of ordinary or sporadic meningitis occurring at the age when cerebro-spinal fever is most frequent are commonly secondary, being due to tubercles, caries of the petrous portion of the temporal bone, or other lesion, and are therefore preceded and accompanied by symptoms which are directly referable to the primary disease. We have seen how different it is in cerebro-spinal fever, which in most patients begins abruptly in a state of previous good health. Again, in cerebro-spinal fever after the second or third day hyperæsthesia, retraction of the head, and other characteristic symptoms occur, which are either not present or are much less pronounced in ordinary meningitis. Some of the milder cases of cerebro-spinal fever might be mistaken for hysteria, but the pain in the head and elsewhere, the muscular rigidity, and especially the occurrence of more or less fever, enable us to make the diagnosis. Continued fever, typhus or typhoid, resembles cerebro-spinal fever in certain particulars, but it lacks the muscular contraction and rigidity which characterize the latter. It does not usually begin so abruptly, with such severe symptoms, especially such severe headache, has less marked fluctuations, and a more definite duration. These facts in connection with the character of the prevailing epidemic will enable us to make the diagnosis. In one instance commencing retro-pharyngeal abscess, probably associated with vertebral caries, was at first mistaken by me for cerebro-spinal fever. The patient was an infant, had a temperature of 104° F., stiffness of the neck with some retraction of the head, and cried from pain when the head was brought forward. The speedy occurrence of two large abscesses in other parts of the system, difficult deglutition, and noisy respiration, led to a digital exploration of the fauces, when the abscess was found and opened.

TREATMENT.—Since in epidemics of cerebro-spinal fever cases are more frequent and severe where antihygienic conditions exist, it is evident that measures looking to the removal of such conditions, measures designed to procure pure air in the domicile, wholesome diet, and a quiet and regular mode of life—in fine, measures designed to produce the highest degree of health—are of the first importance for the prevention of the disease. Cleanliness of the streets and areas, as well as of the apartments, good sewerage and drainage, the prompt removal of all refuse matter, avoidance of overcrowding—in a word, the strict observance of sanitary requirements in every particular—will, there can be little doubt from what we know of the causation and nature of cerebro-spinal fever, diminish the number and severity of the cases. The avoidance of fatigue and overwork and of mental excitement, the use of plain and wholesome diet, sufficient sleep, the utmost regularity in the mode of life, with the least possible exposure to depressing agencies, are the important preventive measures which should be recommended during an epidemic of cerebro-spinal fever.

The enjoining of a quiet and regular mode of life as a preventive measure during the occurrence of an epidemic of cerebro-spinal fever is not inconsistent with the theory that the cause is a micro-organism. It is not unreasonable to suppose that the system may be more or less under the influence of the specific principle, and that this principle may obtain lodgment in the blood or tissues without result until some exciting cause occurs which depresses the system and disturbs the functions, when the resisting power fails and cerebro-spinal fever appears; just as those exposed to Asiatic cholera may remain well until some imprudence in the diet or the mode of life causes an outbreak of the malady.

Curative Treatment.—In the commencement of cerebro-spinal fever intense inflammatory congestion occurs of the cerebral and spinal meninges, and also to a certain extent of the brain and spinal cord. As regards treatment, the obvious indication is to reduce the hyperæmia of the vessels as quickly as possible and subdue or diminish the inflammation. For this purpose bags or bladders of ice should be immediately applied over the head and to the nucha, and constantly retained there as long as there is no complaint of chilliness, no marked diminution of temperature, and the patient experiences some relief from the intense headache and other symptoms. Bran mixed with pounded ice produces a more uniform coldness and is sometimes more agreeable to the patient than the ice alone. The bag or bags should be about one-third full, so as to fit upon the head like a cap, and the nurse should be instructed to renew the ice as soon as it melts. In severe cases with marked elevation of temperature it is proper to apply cold over the dorsal and lumbar vertebræ, as well as upon the head and nucha. A hot mustard foot-bath or a general warm bath in those cases in which convulsions are present or threatening, or in which there is delirium or great agitation or severe peripheral pains, is also useful, since it has a calmative effect and acts as a derivative from the hyperæmic nerve-centres. One writer states that he obtained marked benefit in a case by immersing the body to the neck in hot water.

The abstraction of blood, usually by leeches applied to the temples, behind the ears, or along the spine, has been employed, but even in the commencement of the present century, when it was customary to bleed generally and locally in the treatment of inflammatory and febrile diseases, a majority of the American physicians whose writings are extant discountenanced the abstraction of blood in the treatment of this disease. Drs. Strong, Foot, and Miner, though under the influence of the Broussaisian doctrine, were good observers, and they soon abandoned the use of the lancet and leeches in the treatment of these patients for more sustaining measures. Strong[1] states that certain physicians employed venesection as a means of relieving the internal congestions, but, finding that the pulse became more frequent after a moderate loss of blood, they soon laid aside the lancet. Some experienced physicians of that period, however, continued to recommend and practise depletion, general as well as local, as, for example, Dr. Gallop, who treated many cases in Vermont in the epidemic of 1811.

Venesection in the treatment of cerebro-spinal fever is universally discarded at the present time in this country and Europe, but some intelligent physicians, as Sanderson and Niemeyer, approve of local bleeding in certain cases. It is, in my opinion, after examining the histories of many cases, uncertain whether the abstraction of blood should ever be recommended, but if it

[1] *Medical and Physiological Register,* 1811.

be prescribed it should be on the first day, when the hyperæmia is greatest, by the application of only a few leeches behind the ears, and never except when coma or convulsions are present or threatening and the patient is robust. The fact should not be forgotten that cerebro-spinal fever is in its nature asthenic and protracted, and that the intense inflammatory congestion of the nervous centres can ordinarily be relieved, if relieved at all, by the other measures recommended, which do not reduce the strength. The alarming symptoms which usher in an attack, the intense headache, restlessness, delirium, sometimes eclampsia or coma, seem to demand the most energetic treatment, and yet it is surprising to one who has his first experiences with this malady how patients under proper treatment, without the abstraction of blood, emerge from an apparently almost hopeless state and ultimately recover. There may be total unconsciousness, the pupils dilated like rings and insensible to light, the head intensely hot, tonic convulsions present or alternating with frequent clonic convulsions, and yet these symptoms, which in any other disease would be regarded as sufficient to justify the prognosis of certain death, may gradually pass off toward the close of the first or in the second week, and the case afterward progress favorably. In the New York epidemic of 1872—previous to which physicians of this city had no personal experience with cerebro-spinal fever—many cases were pronounced hopeless which ultimately did well without abstraction of blood. In a case occurring in the practice of Dr. Griswold the patient was comatose for three days, with pupils not responding or but very feebly responding to light, but he recovered without the abstraction of blood and with the remedies ordinarily employed. In a case which we will presently relate in speaking of another local treatment the patient was still insensible in the third week, with pupils greatly dilated and insensible to light, and yet recovered without losing blood. Such cases show that the most urgent symptoms, such as seem to indicate the prompt employment of leeches in order to reduce the meningeal hyperæmia and the consecutive congestion of the nerve-centres, may be relieved and the patient recover without such depletion, and with the preservation of the blood, which is so much needed in the subsequent asthenic course of the malady.

In only one case have I recommended the abstraction of blood, and this was so instructive that I will briefly relate it: A girl four years of age was seized on March 7, 1873, with vomiting, chilliness, and trembling, followed by severe general clonic convulsions lasting about fifteen minutes; was semicomatose; pulse 132, and a few hours later 156; temperature 101¼° F.; respiration 44; eyes closed, pupils moderately dilated and feebly responsive to light, dusky mottling of skin, constant tremulousness with twitching of limbs. Bromide of potassium was administered in hourly doses of four grains, ice applied to the head and nucha, and a hot mustard foot-bath followed by sinapisms to the nucha. On the following day, March 8th, she was partly conscious when aroused, but immediately relapsed into sleep; head retracted, bowels constipated; pulse 136; temperature 102°; vomited occasionally. It was thought proper, on account of the extreme stupor, to apply one leech to each temple, and the bites trickled slowly nearly five hours. The other treatment was continued. On the 9th the pulse was 180—so feeble that it was counted with difficulty; temperature 101½°. The patient was evidently sinking. It was necessary to order whiskey in teaspoonful doses every two hours, with beef tea and other most nutritious drinks. Evening, pulse 172, still feeble. March 10th, pulse 180, barely perceptible; great hyperæsthesia; axillary temperature 100°; axes of eyes directed downward. After this the patient gradually rallied for a time, the pulse becoming stronger and less frequent, but death finally occurred after nine weeks in a state of extreme emaciation and exhaustion. Slight convulsions occurred in the last hours.

It is seen that in the above case, which may be regarded as typical, the patient passed into a state of extreme prostration after the application of the leeches, so that for three days I did not believe that she would live from hour to hour, and death occurred after an illness of nine weeks, apparently from sheer exhaustion. Experience like this, which corresponds with that of most other observers, shows the necessity of preserving the blood, and thereby the strength, however urgent the initial symptoms, inasmuch as cerebro-spinal fever in its subsequent course is attended by such marked asthenia. On May 3, 1878, a boy of ten years was admitted into one of the New York hospitals in the service of a prominent physician. It was stated that he had been four days sick with cerebro-spinal fever, and among other characteristic symptoms he had had delirium every night, and on May 2d delirium in the day-time, which had abated considerably after free epistaxis. In the hospital the application of ten leeches along the spine was ordered, but it does not appear to have diminished the delirium or any other symptom, and the following day the pulse was so frequent and feeble that active stimulation by brandy was resorted to. He had three strong convulsions on May 13th, which were relieved by ice to the head and nape of neck and by six minims of Magendie's solution. Severe pains occurred at times in the back and limbs, and on the 29th, one month after the commencement of the disease, the same pain frequently recurring, twelve leeches were ordered to be applied to the spine. On June 2d the limbs were flexed and quite stiff, and the effort to move them was attended by great pain. The pain in the back was also more constant, and in consequence sixteen leeches were applied to the spine The next day there was no pain, but the patient was very stupid. On June 6th the records state that he was obviously losing strength day by day—that his emaciation was extreme and his anæmia very marked. But he had great vitality, and, although he had strabismus, bed-sores, incontinence of urine and feces, and extreme prostration, he lingered till August 1st. At the autopsy: "Body a skeleton; brain, dura mater, and pia mater appear normal, except a little thickening of latter at base of brain; ventricles much enlarged and full of clear serum; surface of walls of ventricles looks normal, but is soft; spinal cord and membranes appear normal to the naked eye." No disease was discovered in other organs, except that the liver appeared congested and the kidneys pale. It can scarcely be doubted that although some temporary relief from the pain may have resulted to this patient by the repeated application of leeches, which diminished the meningeal hyperæmia, yet his chances for ultimate recovery would have been far better without such depletion. Therefore the histories of cases show that the result of abstraction of blood has been unsatisfactory, on account of the asthenic nature and protracted course of cerebro-spinal fever, and it should never be recommended as a remedial agent.

Some benefit is apparently derived from the application of stimulating and moderately irritating lotions along the spine. A liniment consisting of equal parts of camphorated oil and turpentine briskly applied by friction with flannel up and down the spine till redness is produced appears to cause some alleviation of the suffering, and it does not conflict with the use of the ice-bag. Dr. William H. Sutton of Dallas, Texas, has published the following interesting case, showing the benefit from stimulating and irritant applications over the spine made in an unusual manner: A child aged three and a half years had been three weeks under treatment, through error of diagnosis, for supposed continued fever. When Dr. Sutton assumed charge of the case, November 20, 1877, the pupils were greatly dilated and insensible to light; features pallid and pinched; pulse 130; temperature 103° F.; patient totally unconscious. November 21st, morning temperature 105°, pulse 140;

evening temperature 101¾°, pulse 120. November 22d, morning temperature 106½°, pulse 160; restless; evening temperature 105½°, pulse 120; had not slept, except for moments, for nearly two weeks. A strip of flannel saturated with turpentine was placed over the spine from the neck to the sacrum, and a hot smoothing-iron was run up and down it, and eight drops of the fluid extract of ergot were given every three hours. Dr. Sutton adds: "The father stated to me that as soon as the application was finished the child fell asleep, and slept several hours—the first for two weeks—and the fever rapidly declined. From this time he began to improve, and gradually and fully recovered." The use of irritants and derivatives over the spine in the treatment of cerebro-spinal fever has been long and favorably known, but the mode of producing irritation in the above case was novel.

Internal Treatment.—It will aid in the selection of the proper remedies to recall to mind the pathological state which we know to be present from the many autopsies which have been recorded. We have seen that the largest mortality, and consequently the most dangerous period, is in the first days, when there is intense, suddenly-developed inflammatory congestion of the meninges, with more or less secondary hyperæmia of the underlying brain and spinal cord, producing great headache, delirium, or somnolence, with exaggerated reflex irritability of the spinal cord, so that eclampsia is a common and fatal complication.

Fortunately, a remedy has been discovered in modern times (the bromide of potassium) which acts promptly and efficiently. It can be safely administered in large and frequent doses to the youngest child. It is quickly eliminated from the system through the kidneys and other emunctories in children, so as to prevent the occurrence of bromism, at least to the extent of causing any unpleasant consequences. It causes contraction of the minute vessels of the nervous centres so as to diminish the hyperæmia, as shown by the experiments and observations of Dr. Putnam-Jacobi and others, and at the same time it diminishes, in a marked degree, the reflex irritability of the spinal cord—two most beneficial and important effects of its use in this disease. Many children by its timely employment are saved from the dangers of eclampsia, and by its sedative effect on the nervous system and contractile action on the capillaries it probably diminishes the intensity of the inflammation and the amount of exudation. I usually prescribe it, as recommended by Dr. Squibb, dissolved in simple cold water. In ordinary cases, not attended by eclampsia or marked symptoms which show that eclampsia is threatening, I generally prescribe at my first visit about four grains every two hours to a child of two years who has the usual restlessness and apparent headache, and six grains to a child of five years. If eclampsia occur, the bromide should be given more frequently, as every five or ten minutes, till it ceases. It is important to be able to determine when the quantity of the bromide administered should be diminished and when its use should be discontinued. I have very rarely observed bromism in children, and never to the extent of doing any serious harm, though for many years I have administered it in large and frequent doses whenever the occasion seemed to require it; but the symptoms of bromism cannot readily be discriminated from those which may result from cerebro-spinal fever, such as muscular weakness, dilated pupils, with perhaps impaired vision, unsteady gait, nausea or vomiting, and abdominal pains. If the case progress favorably, frequent and large doses should, in my opinion, be given only in the first week, after which this agent should be given at longer intervals or in smaller doses. But during exacerbations, which are liable to occur from time to time till the patient is well on the way to recovery, the use of the bromide in full doses is again indicated till the urgent symptoms begin to abate.

been eliminated from the system. It is seldom that more than two or three of the joints are in a state of active inflammation at the same time.

The temperature in acute rheumatism is elevated two or three degrees above that of health, and the pulse varies from 120 to 140, its frequency depending on the age of the patient as well as the gravity of the disease. Perspiration is a common symptom. The appetite is impaired, the tongue slightly coated, and the bowels constipated. The watery element of the urine is diminished, as in most febrile diseases, and there is not a corresponding reduction in the solid elements, so that the urine is rendered more dense and its specific gravity is high. The amount of urea and coloring matter excreted from the kidneys is augmented during the active period of rheumatism, and the urine when it cools deposits urates. In ordinary cases there is no prominent symptom referable to the nervous system, with the exception of pain in the affected joint.

Acute rheumatism, if only the articulations were involved, would be a disease of little danger, however painful, but unfortunately in its proneness to produce specific inflammation of the sero-fibrous tissues the heart frequently becomes involved, less frequently the lungs and pleura, and in rare instances the cerebral or spinal meninges. The so-called cerebral rheumatism is attended by high fever, restlessness, headache, and sometimes delirium and coma. Twitching of the muscles and sometimes tonic or clonic spasms occur. Prof. Flint says: "In the majority of cases death takes place during coma. In some cases recovery sets in even after the appearance of very grave symptoms. In fatal cases no lesions of the brain or of the meninges can really be found. The symptoms seem to be referable to some profound infection or intoxication which acts upon the thermic and other nervous centres." This form of rheumatism is certainly rare in childhood. Endocarditis is the most frequent of the heart inflammations occurring in rheumatism; pericarditis, though less common, is not infrequent; while in rare instances myocarditis occurs, usually associated with the other inflammations. Endocarditis is limited to the left side of the heart, and seldom continues long without engaging the valves, aortic or mitral, or both, causing their infiltration, fibroid degeneration, with consequent thickening, and sometimes adhesion. The valvular lesion thus produced is in most instances permanent, so impairing the action of the valves as to obstruct in greater or less degree the flow of blood through the orifice and allow its regurgitation.

The mitral valve is more frequently affected than the aortic; at least *bruits* produced by this lesion are more frequent in the mitral than aortic orifice, and when they are heard in both orifices they are commonly loudest in the mitral. This fact, noticed by different observers, I have repeatedly verified by observations in this city.

I have preserved the records of 73 cases of valvular disease in children, and in most of them I was able to assign rheumatism as the cause, but it was in a large proportion of instances very slight, so as not to confine the patients to bed, and had been considered by the parents simply "growing pains," so that no treatment had been received. The statistics of different observers show that endocarditis in acute rheumatism occurs more frequently in children than in adults. The first sign of an endocardial inflammation is in most instances a systolic murmur produced in the mitral orifice. It can be heard on listening over the heart, and also over the left scapula. It indicates insufficiency of the mitral orifice and regurgitation of blood into the left auricle. In some cases the aortic valves are at the same time affected, and an aortic direct murmur occurs, synchronous with the mitral regurgitant. In rare instances the endocarditis extends to the aortic orifice, causing thickening of its valves and impairing their action, so that an aortic bruit results, rpose the iodide of potassium is probably more useful than any other It is administered by some physicians early along with the bromide, same manner in which they have been in the habit of treating other of meningitis. I have prescribed it with the bromide and alone when romide was discontinued, but whether it produces any marked sorbefa- effect in this disease apart from the removal of serum seems to me ful.

he result depends to a great extent on the nursing. The skill of the ician may be thwarted and the life of the patient lost by inefficient ng. No other disease more urgently requires kind, intelligent, and con- attendance night and day on the part of the nurse. Not only should medicines and nutriment be given punctually and regularly, but the t restlessness of the patient in the first days requires constant readjusting e ice-bags, and during the long period of convalescence the utmost care quired to remove at once the excretions in order to prevent bed-sores, to give the proper amount and kind of nutriment to prevent the emacia- and weakness from which many perish.

The diet, from the beginning to the end of the malady, should be the t nutritious and such as is easily digested. It is necessary to give it in liquid form, unless in mild cases in which the appetite may not be entirely t. It is proper to aid the digestion by pepsin preparations. Nutritive mata, consisting of beef tea or one of the extracts of beef, milk, and ndy, aid in averting the fatal prostration in protracted cases. After the te stage has passed and the meningeal hyperæmia has abated the alcoholic mpounds in moderate doses, which in the beginning might be injurious, ay now be useful, administered regularly by the mouth. The room should e dark, well ventilated, and quiet. All sympathizing friends who are not equired in the nursing should be excluded. I know of no other disease in which this is so necessary, for mental excitement may produce dangerous ggravation of symptoms.

CHAPTER V.

ACUTE RHEUMATISM.

Rheumatism is a constitutional disease with a local manifestation—to wit, inflammation of the fibrous tissues, chiefly in and around the articula- tions, but occasionally in other parts, as the heart and nervous centres. It was formerly supposed to be rare in children, but more accurate observations show that it is scarcely less common during childhood than in adult life. In young patients, especially under the age of six or eight years, it is frequently overlooked, for the articular inflammations in such patients are commonly slight. In the last twenty years, during my connection with the children's class in the Bureau for the Relief of the Out-door Poor, I have examined many children with rheumatism or the cardiac lesions resulting from rheu- matism, and ordinarily I have found that few joints had been affected, and that there had been but little swelling of them or redness, and that the patients were usually not confined to bed, or even to the sitting posture, but had been able to walk about, though with restraint and complaint of pain or soreness. The parents in many instances supposed that their children were suffering from "growing pains," as they designated them. At the same time, with this mildness of symptoms the heart was becoming seriously and permanently crippled by endocarditis. Those who have attended my clinics will re that on some days as many as three or four children with cardiac lesion been present whose histories show an overlooked rheumatism of this mil Cases like the following are very common among the city poor:

In January, 1871, a little girl three years old was presented, having d aortic direct and mitral regurgitant murmurs. The mother was not awa she had had rheumatism, but at the age of twenty months she had for days pretty active febrile symptoms, which the physician attributed to other ailment. In April, 1871, another girl, of the same age, was brou the clinic, having a distinct mitral regurgitant murmur. The mother that she had been well till a month previously, when she was confined bed for a few days, having a high fever. She was attended by a homœ physician, and the exact character of her sickness the mother was not state. Further medical advice was sought, as the child remained d though her health was better than at first. There can be little dou the obscure fever in this case was rheumatic. In another child treat where, not old enough to relate the subjective symptoms, there was, i tion to an intense fever, evident pain in one foot or leg when the li moved. Still, the nature of the disease was not diagnosticated till so after recovery, when a valvular murmur was accidentally discovered. histories, which are not rare, show that rheumatism often occurs in children, even infants, and they inculcate the important practical less the disease at this age may be so obscure or latent as to be overlook by good diagnosticians.

Some observers, meeting cases of valvular disease in children wit history of rheumatism, have concluded that rheumatism is not the chi of endocarditis at this age;[1] but the explanation which I have give to me more in consonance with the facts. Scarlet fever not infre causes endocarditis, but this exanthem seldom occurs without detect it has been as often absent as has rheumatism from the histories as the parents of young children with valvular disease whom I have ex Moreover, the endocarditis of scarlet fever is in many cases associat if it do not result from, scarlatinous rheumatism.

Rheumatism in children is primary or secondary. The second occurs chiefly in the declining stage of scarlet fever and variola. It also to occur occasionally in new-born infants during epidemics of p fever, but I have not observed such cases.

Causes.—An inherited rheumatic diathesis is universally recog an important predisposing cause of this disease, so that it frequentl in different members of the same family. When the family history strong predisposition to rheumatism, it occurs in the child from exciting cause; if no such predisposition exist, it only occurs unusual circumstances of exposure. Investigations have been made to determine whether acute rheumatism is a microbic disease. D Mantle of England made cultures from the serum of 7 and from of 16 patients with acute rheumatism. He states that he made use precaution to prevent contamination by germs from without. The o obtained by Mantle in the cultures were a micrococcus and a small He states that these organisms produced lactic-acid fermentation in milk. He believes that the microbes do not produce the symptoms matism by their direct action, but by the ptomaïnes to which they and he raises the question whether lactic acid is not the chief (*Brit. Med. Jour.*, 1887). Popow states that the micrococci obtaine tivation from the blood of rheumatic patients inoculated in rabbit se animals the characteristic symptoms of rheumatism, and in their and synovial fluid he found the same cocci (*Wiener med. Presse*, Jan. 88). Cornil and Babés have also related a fatal case of rheumatism in micrococci and bacilli were found in the right knee. Wilson found in the pericardium in two cases of rheumatic pericarditis. Pêtrone ied the serum taken from the knee-joint in three cases of acute rheu-, and in all the specimens examined discovered microbes similar to those d by Klebs in rheumatic endocarditis. Jaccoud relates the histories newly-born infants whose mothers at the time of their birth had acute tism. One of them twelve hours after birth, and the other three days irth, "were attacked with fever, rapid pulse, and well-marked rheu-swelling of several articulations." Under treatment one recovered in ays and the other in a little more than two weeks. The above observa-nd support to the theory that acute rheumatism is a microbic disease, rhaps observations indicate that it is to a certain extent infectious.

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[1] Dr. A. Steffen, Jahrbuch für Kinderh., 1870.

ildren who have had one attack are especially liable to another, and he diathesis is acquired slight exposures appear to be sufficient to cause ease. It has heretofore been the common belief in the profession—is opinion is also held by the laity—that exposure to cold is the usual g cause of rheumatism; but if the disease have a microbic origin, it is ion whether or to what extent this theory is true. It is stated in sup-f it that rheumatism is most common in cold and changeable weather those who are most exposed to vicissitudes of temperature.

rlatinous rheumatism has been alluded to above. Frequently during urse of scarlet fever inflammation of certain joints occurs which can-distinguished from that in the ordinary form of rheumatism, and in f these instances endocarditis or pericarditis also occurs. Dr. Ashby ned to believe that scarlatinous rheumatism is produced by septic ng. but it sometimes occurs at such an early stage or in cases of such ss that the conditions giving rise to ordinary sepsis do not seem to be . It is therefore probable, in my opinion, that in some instances at his articular affection occurring in scarlet fever is due to the direct of the scarlatinous microbe or to a ptomaïne or ptomaïnes produced microbe.

IPTOMS.—The commencement of acute idiopathic rheumatism is in ases sudden; occasionally fever and a degree of soreness or stiffness the articular affection for a few hours or days. The inflammation, t first, increases gradually, attaining its maximum intensity within one days. The joint is painful, red, hot, and swollen. The swelling is inflammatory œdema of the tissues surrounding the joint and effusion the joint. As in all inflammations, the vascularity of the parts d is increased, the synovial membrane loses, more or less, its lustre, effused fluid, which is mainly serum, has been found, in most of the which an opportunity was presented of examining it, to contain a few tes. Rarely fibrin is exuded, producing a rubbing sensation when nt is moved, and perhaps impairing the mobility of the articular s. Fortunately, however, in a large majority of cases the substance both without and within the joint is mainly serum, and hence the bsidence of the swelling when the inflammation ceases. The pain is ly not severe when the child is quiet, but it is greatly increased if the e pressed or the limb moved.

joints of the extremities are most frequently the seat of rheumatic ation, but occasionally those of the trunk, as the intervertebral, the sis pubis, etc., are involved. As the inflammation abates in the artic-*first affected it reappears* in others, unless the materies morbi have

urine is diminished, as in most febrile diseases, and there is not
ing reduction in the solid elements, so that the urine is rendere
and its specific gravity is high. The amount of urea and co
excreted from the kidneys is augmented during the active peri
tism, and the urine when it cools deposits urates. In ordinary
no prominent symptom referable to the nervous system, with
of pain in the affected joint.

Acute rheumatism, if only the articulations were involved, w
ease of little danger, however painful, but unfortunately in its
produce specific inflammation of the sero-fibrous tissues the he
becomes involved, less frequently the lungs and pleura, and in
the cerebral or spinal meninges. The so-called cerebral rheumati
by high fever, restlessness, headache, and sometimes deliriu
Twitching of the muscles and sometimes tonic or clonic spasms
Flint says: "In the majority of cases death takes place duri
some cases recovery sets in even after the appearance of very
toms. In fatal cases no lesions of the brain or of the menin
be found. The symptoms seem to be referable to some profoun
intoxication which acts upon the thermic and other nervous ce
form of rheumatism is certainly rare in childhood. Endocardit
frequent of the heart inflammations occurring in rheumatism
though less common, is not infrequent; while in rare instance
occurs, usually associated with the other inflammations. E
limited to the left side of the heart, and seldom continues
engaging the valves, aortic or mitral, or both, causing thei
fibroid degeneration, with consequent thickening, and someti
The valvular lesion thus produced is in most instances perman
ing the action of the valves as to obstruct in greater or less d
of blood through the orifice and allow its regurgitation.

The mitral valve is more frequently affected than the aortic;
produced by this lesion are more frequent in the mitral than aor
when they are heard in both orifices they are commonly loudest
This fact, noticed by different observers, I have repeatedly veri
vations in this city.

I have preserved the records of 73 cases of valvular diseas
and in most of them I was able to assign rheumatism as the

the mitral orifice is not affected, and therefore no mitral murmur
.

other cardiac bruit resulting from the endocarditis occasionally observed
duplication of the second sound, heard most distinctly at the apex. A
lic sound sometimes follows this reduplication, and when it is well devel-
t constitutes the so-called presystolic murmur. It usually results from
l stenosis caused by the endocarditis.

ericarditis is not so common in rheumatism as endocarditis, but it some-
occurs in children as well as in adults. It occasionally even precedes the
ion of the joints, being the first in time of the rheumatic inflammations.
uses an increase in the fever, palpitation, quick and irregular pulse, rest-
ess, cardiac pain, and perhaps dyspnœa. At first a pericardial friction-
d may be detected, and subsequently, when sero-fibrinous exudation has
rred, the area of dulness may be increased, with a muffling of the sounds
he heart. If the effusion of serum be moderate, the pericardial sur-
s may become agglutinated early in the disease, or they may become
lutinated after the serum is absorbed, so as to prevent friction-sound. An
erent pericardium embarrasses the action of the heart, and is likely to lead
tually to hypertrophy. Tonsillitis occurs so frequently in children who
the rheumatic diathesis, and also so frequently during rheumatism, that
sseau recognized a rheumatic form of the disease. Bronchitis, pleurisy,
pneumonia also occasionally occur as complications of rheumatism.

While the articular affections pertain to the clinical history of rheumatism,
internal inflammation, whether of the heart, lungs, pleura, or meninges,
gh similar as regards its pathological character, is properly considered as
mplication. Acute rheumatism is so frequently complicated by one or
other of these affections that any disproportionate severity in the general
ptoms, as compared with the inflammation of the joints, or any sudden
unexpected increase in the symptoms, should always lead the physician
xamine thoroughly the condition of those organs which are most frequently
cted.

Inflammatory complications occur, as a rule, during the active period of
umatism, when the inflammation is passing from joint to joint. If the
eral symptoms begin to improve and no new joints are involved, the
ility to complications is greatly diminished.

PATHOLOGY.—The joints affected by rheumatism present various grades
inflammation, but in all typical cases, however intense the inflammation,
puration does not occur. In a paper read before the London Medical
iety, April 9, 1888, Dr. Money stated that when suppuration does occur in
umatism the disease is complicated with sepsis, and Sir Wm. MacCormac
Dr. Ord expressed a similar opinion.

Acuteness of sensation is increased over the inflamed joint. The ana-
ical changes in the joints have been sufficiently described in our remarks
ting to the symptoms. Recently several writers have called attention to
fact that nodules occasionally occur under the skin in rheumatism.
dmann relates two cases, an adult and a child, in which during the course
heumatism numerous nodules appeared rapidly under the skin. They
about the size of a pea, hard, movable, and painful, but without red-
They disappeared during convalescence. Lindmann collated the rec-
of 59 rheumatic cases in which nodules occurred. A majority of them
females, and 46 were children. These bodies usually appeared suddenly
e later stages of rheumatism, and varied from the size of a pin's head
at of an almond. They continued from a few days to a month or longer
sche medin. Woch., p. 519, 1888). Examination with the microscope
s that they consist of newly-formed connective tissue, such as results

from inflammation (*Amer. Jour. of Med. Sci.*, Oct., 1888). Garrod stat these nodules and muscular atrophy sometimes occur in the most simple of hydrarthrosis, and are usually attended by an increase in the reflexe gesting an excitability of the spinal cord (*Lond. Lanc.*, June 2, 1888), stated that Charcot and Parisot also attribute the occurrence of these n to an exaggerated excitability of the spinal cord. On the other hand, and Cuilleret observed two cases of nodules and atrophy of certain following an attack of arthrit they think that a true myelit occurred to produce such a result with the constant peripheral ir (*Lyons Médical*, Apr. 29, 1888). relates the case of a patient ag teen years who had rheumatism muscles of the left leg from the the ankle, lasting several wee the latter part of his sickness th of the leg became unusually tend a hard nodule occurred in the mu substance, and was accompani atrophy of the muscular fibres. nodule gradually subsided and peared (*St. Louis Courier of* March, 1888). The above ob tions, to which more might be show that the anatomical charact acute rheumatism are not restric the joints and heart, but subcutaneous nodules, and more or less mu atrophy, occasionally occur. Cheadle says the nodules occur mostly neighborhood of joints, and that they are rare in adults, but very comm children. They develop within a few days, and sometimes in successive "but they usually take many weeks to subside." The above figure repr these nodules as seen by Dr. Cheadle in a boy of four years.

FIG. 31.

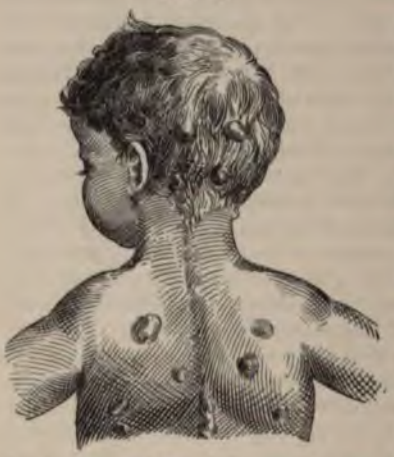
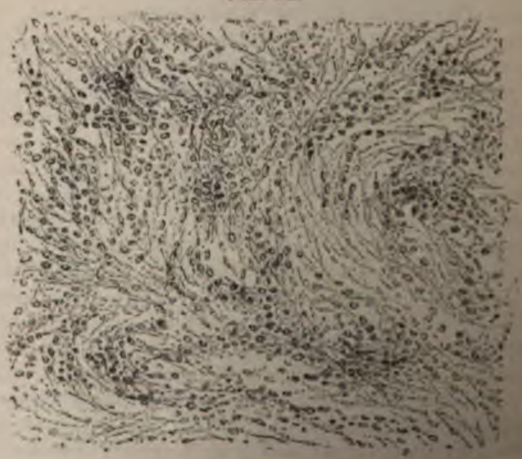


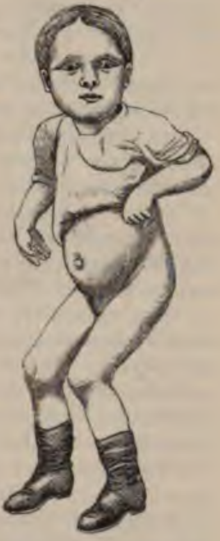
FIG. 32.



The woodcut (Fig. 32) shows the microscopic appearan of seven and a half years, as observed by Dr. Cheadle; it exhibits the cell-infiltration and proliferation of fibrous tissue:

URATION; PROGNOSIS.—With proper treatment and without complica- he febrile action in a few days begins to abate, and the disease com- terminates within two weeks. Its duration is ordinarily shorter than eumatism of the adult. Fluctuations, however, are liable to occur. lisease may appear to be abating and the articular inflammations nearly when they return for a time, often without new exposure and without ciable cause. The prognosis, even when cardiac inflammation has super- l, is in most cases favorable, except so far as the lesion resulting from nflammation is concerned, which being permanent may entail much sub- nt suffering and occasion death after months or years. Indeed, what st to be dreaded in cases of acute rheumatism is lar disease or pericardial adhesion with its remoter quences—namely, hypertrophy of heart, conges- nd œdema of lungs, dropsies, etc.

FIG. 33.



condary rheumatism occurring in scarlet fever is imes also complicated with, or rather coexists cardiac inflammation, pleuritis, or pneumonitis, ring the prognosis more unfavorable.

rare instances the acute symptoms of rheuma- abate, but the joints remain stiff and more or wollen and painful when moved. The acute has l into a subacute or chronic rheumatism. Such e, represented in the accompanying figure, was ht to the children's class in the Out-door Depart- at Bellevue Hospital in February, 1871. E. –, a female three and a half years old, had inter- it fever from the age of nine to fifteen months. this time she remained well till the age of two when she was taken with acute rheumatism, encing in her ankles and extending to other s. The knee- and hip-joints on both sides have partially recovered their mobility, and both legs oth thighs are permanently flexed, so that the gait w and unsteady. It is impossible to straighten limb without causing great pain, and attempts to straighten the thigh ce the arch in the back very similar to that in coxalgia.

IAGNOSIS.—This is not difficult in ordinary cases if a proper examina- be made. In the commencement, if the affection of the joints be rheumatism might be mistaken for remittent, typhoid, one of the ve fevers, or meningitis; but on careful examination tenderness of one re of the articulations will be observed, and probably some swelling. tenderness is readily distinguished from the hyperæsthesia which is on in the first stage of the essential fevers, and which is observed when are is made upon the chest or abdomen as well as upon the limbs, and is marked between the joints than in them. Any doubt which may at first whether the patient may not have one of those diseases is soon dispelled, their clinical history presents notable differences from that of rheumatism. have known scrofulous arthritis or scrofulous osteitis near the joint nt so close a resemblance to acute rheumatism as to be at first mistaken In one instance this inflammation commenced nearly simultaneously ree joints, rendering the diagnosis at first very difficult. But scrofu- nflammation, as well as that from pyæmia, can be diagnosticated from atic disease of the joints by its greater persistence, less induration and symmetry in the swelling, and by the history of the case. Chronic rheumatism may produce deformity similar to that from chronic scrofulous inflammation, as in the case mentioned above, but the rheumatic history, number of joints affected, bilateral character of the inflammation, good general health, etc. are sufficient to establish a clear diagnosis when the disease has been observed for some days.

TREATMENT. — The treatment of acute rheumatism has undergone marked variations in the last thirty years. Its speedy cure is urgently demanded, on account of the imminent peril to the heart. From 1847 until a recent period the alkaline treatment, by the bicarbonate of potassium and bicarbonate of sodium, the tartrate of potassium and sodium, and the citrate of potassium, was commonly employed to the extent of rendering the urine alkaline in twelve or twenty-four hours. Statistics appeared to show that the duration of rheumatism was abridged by the alkaline treatment, and the liability to cardiac complications was diminished as soon as the urine became alkaline. Garrod reported 50 cases in which the average duration was six or seven days under the alkaline treatment. Fuller in 1862 stated that in no single instance in 194 cases did cardiac complications occur when the alkaline treatment had been employed twenty-four hours. Dickinson's statistics also furnished strong evidence of the usefulness of alkalies in large doses, given so as to render the urine alkaline in twelve to twenty-four hours. He also stated that the alkaline treatment was inadequate unless employed so as to render the urine alkaline. More recently, the late Prof. Austin Flint considered the evidence conclusive in regard to the efficacy of the alkaline treatment of rheumatism, the doses employed being so large that the urine becomes alkaline in twenty-four hours.

But since 1875 a new and, in acute cases of rheumatism, a very efficient remedy has come into use—to wit, salicylic acid or its compound, salicylate of sodium. The sodium salicylate is most frequently employed. It may be given every two hours to adults in doses of ten to twenty grains, and to children in proportionate doses. But, although salicylic acid or salicylate of sodium acts almost as a specific in recent cases of rheumatism, relieving the pain and fever and diminishing the articular inflammation, it often produces certain ill effects. It impairs digestion, causing nausea, and sometimes vomiting. It produces tinnitus aurium, and sometimes headache or vertigo, and occasionally albuminuria, as I have several times observed, so that it should not be employed longer than is required to control the rheumatism. The employment of salicylic acid or salicylate of sodium does not, apparently, prevent cardiac or other complications, and it is probably best to administer it in combination with, or alternately with, an alkali.

The following formula is essentially that which has been employed in the Out-Door Department at Bellevue with apparently excellent results:

℞. Acidi salicylic.,	ʒij-iij;	
Potas. acetat.,	℥ss;	
Glycerinæ,	℥j;	
Aquæ, q.s. ad	℥v.	Misce.

Give one teaspoonful every two or three hours to a child of six years.

An eligible vehicle for the sodium salicylate is the syrup of raspberry, as in the following formula:

℞. Sodii salicylat.,	ʒiij;	
Sodii bicarbonat.,	ʒij;	
Syr. rubi idæi,	℥ij;	
Aquæ,	℥iij.	Misce.

Give one teaspoonful every two or three hours to a child of six years.

Since the oil of wintergreen contains a considerable amount of salicylic acid, it has been sometimes employed, as in the following formula:

℞. Ol. gaultheriæ, ʒj;
Sodii salicylat., ℥iij;
Syr. simplic., ℥iij;
Aquæ, ʒvj. Misce.

Dose: A dessertspoonful to a child of five years.

During the declining period of rheumatism and in convalescence quinine or some preparation of cinchona should be employed and the above medicine given less often. This tonic does indeed appear to exert a beneficial effect on the course of rheumatism, and is employed by some judicious and experienced physicians from the commencement.

If there be a high temperature and a quick pulse, quinine administered in an occasional large dose will be found very useful. Three to five grains may be given to a child of five years.

Rheumatism impoverishes the blood, and the patient often begins to present an anæmic appearance, when he requires iron in addition to the vegetable tonic. The citrate of iron and quinine may then be employed.

Secondary rheumatism requires sustaining treatment from the first. Such cases ordinarily do well without antirheumatic treatment, with the general supporting measures employed for the primary disease.

Antipyrine has recently been prescribed in adult cases during the acute stage with such marked relief of the pain and reduction of temperature that it promises to be a valuable remedy. Fränkel administered it to 34 patients between the ages of fourteen and twenty-eight years in doses of fifteen grains every three hours. In 2 of the cases it disagreed, and was discontinued. In the other cases it speedily relieved pain and reduced the fever (*Deutsche med. Woch.*, 1887). Dr. N. S. Davis, Sr., obtained equally favorable results from the use of antipyrine, but relapses and cardiac complications occurred in about the same proportion of cases as during the use of the salicylates. Antipyrine has not yet been sufficiently employed in the treatment of rheumatism of children to determine its value or safety.

Salol has also been largely used in adult cases during the last two or three years, but Rosenberg of Berlin states that it produces all the unpleasant effects of the salicylates, and does not appear to be any more efficacious in the treatment of rheumatism. Dr. Lombard of Paris believes that it is resolved into salicylic and carbolic acids in the system, and unless this decomposition occurs it is inert. He believes that its value has been overestimated in the treatment of rheumatism. Salol, if administered to children, should certainly be given in small doses, on account of the danger of poisoning from the carbolic acid in its composition. It will therefore probably not come into use as a remedy for the rheumatism of children.

Pneumonitis complicating rheumatism is best treated by moderate counter-irritation and emollient poultices and the internal use of carbonate of ammonium or quinine. In pericarditis or endocarditis if, as is commonly the case, the movements of the heart be accelerated, aconite or the tincture or infusion of digitalis is demanded to the extent of reducing the number of pulsations to near the normal frequency. A child of six years can take three drops of the tincture or a large teaspoonful of the infusion, to be repeated, if necessary, in three hours till the reduction of the pulse is effected. Patients often experience relief by the use of this agent from the palpitation and dyspnœa consequent upon the embarrassed movements of the heart. If the heart disease be severe and pulse feeble, quinine is also useful. The tincture of strophanthus or that of spartein is sometimes prescribed as a substitute for the digitalis.

The patient should be kept quiet in a room of uniform temperature, and not exposed to draughts of air. By such precautions the danger of complications is greatly diminished. Repellant applications, as cold or irritants, should not be applied to the joints so long as the disease is acute, for they also increase the danger of complications. The affected joints should be enveloped in flannel or cotton, and the pain, if intense, may be diminished by applying flannel wrung out of warm water. If the disease become subacute or chronic, if the urates have disappeared from the urine, and the inflammation cease to pass from joint to joint, the tincture of iodine or moderately stimulating embrocations applied to the joints involve no danger and are useful.

CHAPTER VI.

ERYSIPELAS.

THE term "erysipelas" is applied to a constitutional or blood disease which is characterized by inflammation of the skin and subcutaneous connective tissue and a tendency to spread. It is accompanied by pungent and pricking heat, swelling, and subcutaneous infiltration.

In rare instances, in young infants, an inflammation which has been designated erysipelas occurs in and around the umbilicus. It commences about the time of the detachment of the umbilical cord, and is accompanied by redness of the skin and tumefaction, with induration of the connective tissue surrounding the umbilicus. It usually causes ulceration of the umbilical fossa, and in fatal cases pus is sometimes found in the umbilical vessels. This disease does not show any tendency to spread; the diameter of the inflamed surface is not more than three or four inches, with the umbilicus at the centre. It is generally fatal, but two favorable cases have been reported to me, in one of which there was considerable ulceration, and after recovery a firm cicatrix occupied the site of the umbilicus. The most reasonable view is that this disease is primarily an inflammation of the umbilical fossa and vessels induced by uncleanliness, cachexia, or other cause. It lacks the distinguishing feature of erysipelatous inflammations—namely, the tendency to spread—and I shall therefore take no further notice of it in this connection. (See Diseases of the Umbilicus.)

Erysipelas occasionally occurs in childhood; the cases which are met in this period present nearly the same features and pursue nearly the same course as in the adult. In infancy erysipelas is a common disease, and the following remarks relate chiefly to erysipelas occurring in this period of life. They are based on data derived mainly from the records of cases which occurred in this city, some in my own practice, and others in the practice of physicians known to be good observers. The points of chief interest in 41 cases are embraced in the opposite table:

Cases of Infantile Erysipelas.

Age.	Point of commencement.	Parts affected	Duration.	Result.
5 months.	Right knee.	Entire surface, except face and scalp.	5 weeks and 3 days.	Recovered.
2 years.	Left knee.	From a little above the knee to the ankle.	7 days.	Recovered.
10 months.	Elbow.	Whole arm and forearm.	. . . .	Recovered.
20 "	Below right knee.	Entire leg, thigh, and trunk to the umbilicus.	7 days.	Recovered.
"	Vulva.	Abdomen, chest, and all the extremities.	18 "	Recovered.
days.	Genitals.	Both lower extremities, abdomen to the umbilicus.	6 "	Died.
1 year.	Vulva.	Entire surface, except face.	6 weeks.	Recovered.
5 weeks.	At or near the ear.	Forehead and side of face.	1 week.	Died in tetanic spasms.
9 months.	Epigastric region.	Trunk and lower extremities.	2 weeks.	Died in tetanic spasms.
10 "	At angle of mouth.	Entire face and scalp.	10 days.	Recovered.
4 weeks.	Vulva.	Entire surface, except face.	3 weeks.	Died.
3 months.	Vulva.	Surface of abdomen to umbilicus and right lower extremity.	2 "	Recovered.
4 to 5 mos.	Vulva.	All the limbs and trunk, except the chest.	3 to 4 weeks.	Died.
5 months.	From syphilitic sores around anus.	Trunk and both lower extremities.		
3 "	Vulva.	Entire trunk and both upper extremities.	3 weeks.	Recovered.
8 "	Face near nostrils.	Entire trunk and both upper extremities.	About 2 weeks.	Recovered.
4 "	Vulva.	Entire trunk and all the extremities.	1 week.	Died.
7 "	Knee.	A portion of trunk and both lower extremities.	3 weeks.	Recovered.
6 "	Near the ear.	Entire face and forehead.	10 days.	Recovered.
7 days.	Left eyelid.	Left side of face.	3 "	Died.
14 "	Genitals.	Extended to knee, over abdomen to the chest.	4 "	Died.
3 months.	Under the chin.	Chin, left cheek, neck, left side of trunk, left thigh and leg.		
28 "	Right shoulder.	Arm and forearm.	1 day.	Died in convulsions.
3 or 4 days.	Vulva.	Body and all the limbs.	12 days.	Died.
3½ mos.	Under left ear.	Neck, chest, and arms.	About 2 weeks.	Died.
7 months.	Below right knee.	Trunk, neck, and head, and all the limbs.	2 weeks.	Died comatose.
6 "	Vulva.	Both thighs and nearly entire trunk.	3 days.	Died comatose.
19 "	Near point of vaccination.	Shoulder, arm, and forearm.	21 "	Recovered.
4 "	Near point of vaccination.	Chest and both upper limbs.	2 weeks.	Recovered.
2 "	Near vaccine vesicle.	Trunk and all the limbs.	10 days.	Died.
3 to 4 mos.	Near vaccine vesicle.	Arm, forearm, and shoulder on one side.	2 to 3 weeks.	Died.
4 months.	Near vaccine vesicle.	Arm, forearm, and trunk.	2 months.	Died.
2 "	Near vaccine vesicle.	Nearly entire surface.	1 week.	Died with peritonitis.
5½ "	Near point of vaccination.	Arm and forearm.	. . . .	Recovered.
2½ "	Near point of vaccination.	Arm.	7 days.	Died probably of peritonitis.
"	Near vaccine vesicle.	Arm and forearm.	17 "	Died.
"	Left foot.	Leg, thigh, and lower part of trunk.	2 weeks.	Died with pneumonitis.
weeks.	At one ear.	Entire surface.	2 "	Recovered.
months.	Left leg.	Trunk and all the limbs.	2 "	Recovered.
"	Near point of vaccination.	Trunk and all the limbs.	2 "	Died.
4 "	Face.	Trunk and all the limbs.	4 "	Recovered.

GE.—Of the above cases, 27 were under the age of six months, 9 from onths to twelve, and only 5 above the latter age. A large majority, ore, of cases of infantile erysipelas occur in the first year of life.

INT OF COMMENCEMENT.—In 58 cases in which I have ascertained oint of commencement it was in 13 cases the vulva, 17 the arm after vaccination, 7 the leg, 6 the face, 3 the male genital organs, 3 at or near the ear, 1 the elbow, 1 the shoulder, 1 the nates, 1 the foot. In the adult, idiopathic erysipelas commonly commences upon the face and affects only the face, ears, forehead, and scalp. On the other hand, in infantile erysipelas statistics show that the rash commences upon the face only in a small proportion of cases, 1 in 9, and that it rarely extends to the face when it commences in other parts.

CAUSES.—The fact that erysipelas is infectious has led to many microscopic examinations in order to discover the nature of the microbe which causes it. In most instances some injury of the surface has occurred through which the poison is received—a scratch or abrasion or a slight cutaneous eruption. Many instances have been cited showing infectiousness. In my practice a child contracted it from lying in bed with one of the family who had facial erysipelas. The following cases were related before the Paris Academy in 1864: Dr. Paintevin contracted erysipelas from two cases occurring in a hospital ward, and was visited by Dr. Testart of Guise, a place free from erysipelas. Three days after returning home this physician sickened with erysipelas. His servant, who waited on him, and a relative living twenty-four miles away, who called on him, also contracted the disease. The relative's wife was then seized with it, and also three members of a family who had called upon them. These last patients communicated the disease to a relative and two Sisters of Mercy who nursed them. These sisters, returning to the convent, infected others, among whom was the physician of the convent, who died. The physician's daughter also contracted it, the inflammation beginning in leech-bites which had been made over enlarged glands. Infectiousness has been shown not only by clinical experience, but also by experiments; small tumors have been successfully inoculated with cultures of the erysipelatous cocci, but some of the patients thus treated have died. The attempt to remove tumors by inoculating them with the erysipelatous virus shows the highly infectious character of erysipelas, and certain small tumors have been removed by the erysipelas, while in other instances the result has been disastrous, death occurring.

Fehleisen has discovered the specific microbe of erysipelas—to wit, a streptococcus or chain-coccus, which he has cultivated, and by inoculating the cultures he has been able to reproduce erysipelas in tumors. More recently Mëërovitch made microscopic examinations in thirty-one cases of erysipelas, and invariably found a large number of these streptococci in the affected skin, and in grave cases also a few in the blood. He detected this organism in abscesses and in fatal cases likewise in internal organs. The cultures made in meat bouillon preserved their vitality four or five months. It is now known that this organism sometimes passes from the maternal organism to the fœtus through the uterine circulation. Ziegler says that the micrococcus which causes erysipelas enters the lymphatics and spreads chiefly by them. They are found, says he, in immense masses or swarms in the lymphatics, and from them they spread into the tissues, where they excite inflammation and often tissue-necrosis (*Lond. Med. Recorder*, Nov. 20, 1888).

The blood may undergo certain changes which predispose to erysipelas or render the system less able to resist the micrococcus. Among the causes which produce this state of system, uncleanliness, residence in damp, dark, and crowded apartments, and defective alimentation hold a principal place. Hence this disease is more common in the poor quarters of a city than in the country, and in dispensary and hospital than in family practice.

In a large proportion of cases there is an irritation or inflammation at some point, generally trivial, through which the streptococcus enters the system. Erysipelas therefore commonly begins at a simple ecthymatous or impetiginous eruption, around burns or suppurating sores or syphilitic eruptions; it frequently commences, as is seen by the above table, near the point of vaccination immediately after vaccination or when the pock is developed, or again when it has run its course and been detached. In a considerable proportion of cases it begins at the point where the skin is thin and delicate, or where it unites with a mucous surface, probably produced by some uncleanliness or irritation of those parts. Thus, I have records of cases in which it commenced at the external ear, commissure of the mouth, and at the vulva. Indeed, the frequency with which it commences at the vulva renders female infants more liable to it than males. In some instances erysipelas begins without any local exciting causes upon smooth and sound skin, even when there are sores upon various points of the surface.

Vaccination, as an exciting cause of erysipelas, demands particular notice. Often, doubtless, it is the inflammation which necessarily arises from the cut or vesicle which operates as an exciting cause of the erysipelatous affection, and not any deleterious property contained in the virus which is employed, so that an equal degree of inflammation occurring in any other way, as from a burn, would be attended by a like result. But facts show that the virus itself occasionally contains a latent noxious principle, which, introduced into the system, operates as a cause of erysipelas. Thus, a little girl was vaccinated by me in November, 1860, and about the time when the vesicle began to fill she was seized with severe inflammation of the fauces, attended by tumefaction and infiltration of the submucous connective tissue. The inflammation rapidly subsided, and within a week from its commencement the throat affection had nearly disappeared. I now believe that the disease of the fauces was erysipelatous, although it was not suspected at the time to have this character.

As the girl was otherwise healthy and the vaccine vesicle passed through its usual stage and presented the usual appearance, the scab was employed six weeks afterward to vaccinate two infants. Within twenty-four hours after vaccination both these infants were seized with high fever, ushering in severe erysipelas, commencing in one around the point of vaccination, and in the other around syphilitic sores near the anus. In the former case the erysipelatous rash extended from the shoulder over the entire limb, and was obstinate, twice reappearing and extending over the same surface; in the latter (a mulatto child) it extended over both lower extremities and a considerable part of the trunk, when the case passed into the hands of another physician, and the result is not known. The instrument with which the vaccinations were performed was clean. The vaccine disease did not appear in either of these cases.

Again, a well-known physician of this city vaccinated three infants, one his own (No. 32 of the table), with part of a scab which had been pronounced good, but was taken from a child that he had not seen and with whose state he was not familiar. These infants were all affected with erysipelas from the vaccination, his own dying. He had taken the precaution to rub the lancet on his boot before using it. Another physician of this city has informed me that he vaccinated two children in the same family with a scab, with all the precautions that he ever had used, and both were soon after affected with erysipelas of a severe form, extending from the point of vaccination; the vaccine disease did not appear. I have heard of no case in which the vaccine lymph gave rise to erysipelas, and probably it rarely or never does. In the lymph there is no admixture of foreign substances, whereas in the scab there is a large proportion of animal matter.

Erysipelas neonatorum is treated of in our remarks on Sepsis of the New-born, page 143.

PREMONITORY SYMPTOMS.—Infantile erysipelas in certain cases has no premonitory stage, or, if present, it escapes notice. In other instances there are well-marked precursory symptoms, as drowsiness or restlessness, more or less fever, oppressed respiration, with perhaps vomiting and sudden twitching of the limbs. In Cases 28 and 37 of the table, which occurred in my practice, the fever, restlessness, and dyspnœa were so great for three days before the appearance of the eruption as to cause much anxiety. In the adult erysipelatous patient, pharyngitis often precedes the occurrence of the rash upon the skin. The same inflammation may be present in the premonitory period of infantile erysipelas, as well as during the period of erysipelatous eruption. The hurried and difficult respiration which is present in the commencement of some cases is probably due to an erysipelatous turgescence of the bronchial mucous membrane.

Symptoms.—The patient with this disease is usually restless in consequence of the burning pain which accompanies the eruption. In severe cases there is little sleep, night or day, except from medicine. The sleep is short, and is often interrupted by sudden starting or twitching of the limbs. Convulsions may occur, but are not common.

Fever is constantly present, and is proportionate to the extent and gravity of the erysipelas. I have notes of cases in which the pulse was more than 200 per minute, although other symptoms did not indicate immediate danger. The skin not affected by erysipelas is dry and hot, though not possessing the pungent heat of the inflamed portion; face often flushed; tongue moist and covered with a light fur; stomach usually retentive. The state of the bowels varies; sometimes they are regular, sometimes variable, and in other cases the stools are green and more frequent than natural. I have records relating to the state of the bowels in 20 cases, as follows: in 7, regular; in 9, loose; in 2, constipated: in 1, constipated, then loose; and in 1, constipated, then regular. Diarrhœa, when present, is usually mild, requiring little or no treatment. The erysipelatous redness is not in all cases so pronounced as in the adult, but otherwise there is nothing peculiar in its appearance. In feeble infants with an impoverished state of the blood its color is pink, instead of the deep red which characterizes the inflammation in the robust. Points of vesication may occur where the inflammation is most severe, as in the adult, and subsequently the same desquamation and œdema.

If the infant be debilitated there is great danger of the formation of abscesses around which the inflammation lingers after it has disappeared from every other part of the body. Sometimes also in very young infants gangrene occurs, especially in the genital organs in the male. Several of these cases have been related to me, all under the age of a month or six weeks, and all fatal. Occasionally the sloughing is so great as to denude the testicle. A noteworthy feature of erysipelas in infants is its proneness to return. When it has been progressively subsiding and hope is entertained of its speedy disappearance, it not infrequently is suddenly relighted from some unknown cause, travelling again over the same or parts of the same surface. In one case the disease, arising from vaccination, extended three times over the arm and forearm; and in another case a second time over both legs and a considerable part of the trunk.

The internal inflammations which most frequently complicate erysipelas and give rise to symptoms which are superadded to those pertaining to the erysipelas are pharyngitis and peritonitis, and more rarely broncho-pneumonia or enteritis. In a case which I examined after death in the Nursery and Child's Hospital, and in which, the erysipelatous inflammation having extended over the abdomen, the lesions of peritonitis were present, it appeared from the thinness of the abdominal walls that the inflammation had extended through them from the external to the internal surface or from the skin to the peritoneum.

PROGNOSIS.—Erysipelas is much more fatal in infancy than in adult life. In the death-statistics of this city for three years I find 80 deaths from erysipelas of infants under the age of one year to 83 deaths from this disease above that age. Age greatly influences the prognosis. Infants under the age of three weeks usually die; from the age of three weeks to six months the result is doubtful; while above the age of six months a majority recover with correct treatment. It will be seen by the foregoing table that 7 infants under the age of six weeks had erysipelas, and 6 died; from the age of six weeks to six months, 6 recovered and 9 died; and above the age of six months, 9 recovered and 4 died.

With the exception of a case of the so-called umbilical erysipelas, the youngest child who recovered of whom I have obtained information was three weeks old. In this case the rash extended nearly over the entire surface, beginning with the face. Case 38 of the table, treated by myself, was very similar as regards the extent of the erysipelatous eruption and the result. This infant was five weeks old.

It is scarcely necessary to state that erysipelas is more favorable when it affects the limbs than when it invades the head, neck, or body; when it spreads slowly than rapidly; when it is superficial than when phlegmonous. In those cases in which the connective tissue is much involved the infant is not always safe after the disease has run its course; he sometimes dies exhausted from the discharge of abscesses; I have records of two such cases.

DURATION.—In 16 cases that recovered the erysipelas terminated within the first week in 2, the second week in 6, the third week in 5, fourth week in 1, and in 2 cases it lasted five and six weeks. The average duration was fifteen days. In 19 fatal cases, 10 died within the first week, 5 the second week, 3 the third week, and 1 in the fourth week. The average duration of fatal cases was about ten days.

MODES OF DEATH.—Death occurs in different ways: in chronic or tonic convulsions followed by coma, from exhaustion, and from internal inflammation, that from exhaustion being probably the most common.

PATHOLOGICAL ANATOMY.—The blood doubtless in this disease undergoes certain pathological alterations previously to the occurrence of the eruption, but the exact changes are not known. Our knowledge of the morbid anatomy of erysipelas relates chiefly to the local affections, which, with the exception of the inflammation of the skin, are not constant, and may therefore be regarded as complications. The cutaneous inflammation affects all the structures of the skin, and in greater or less degree also the subcutaneous connective tissue. The inflammation is accompanied by more or less serous effusion or œdema.

The not infrequent occurrence of peritonitis in connection with erysipelas has long been known. In Heberden's *Epitome Morborum Puerilium* the anatomical character of erysipelas is expressed in one sentence: "When the body has been opened after death the intestines have been found glued together and covered with coagulable lymph." Since Herberden's time nearly all who have written on diseases of infancy and childhood have mentioned peritonitis as one of the most common complications of erysipelas. Underwood says: "Upon examining several bodies after death the contents of the body have frequently been found glued together and their surface covered with inflammatory exudation, exactly similar to that of women who have died of puerperal fever." Similar remarks in reference to the frequency of peritonitis in this disease are made by recent writers.

The statistics in reference to erysipelas as well as peritonitis show that in infants in hospital practice, and in those affected by erysipelas during epidemics of puerperal fever, peritonitis is a not infrequent complication. On the other hand, as we commonly meet cases of infantile erysipelas occurring sporadically in private practice, abdominal distension and tenderness are not sufficient to indicate peritonitis. In only one of the cases embraced in the foregoing table was a post-mortem examination made, and in that there had been no peritonitis. The occurrence of pharyngitis in connection with erysipelas has been already mentioned.

Enteritis has been alluded to as another complication in infants. Diarrhœa has been stated to be a symptom in certain cases, and it has been found to be dependent on enteritis of a mild grade. Billard made post-mortem examinations of 16 infants who died of erysipelas, and "found in 2 gastro-enteritis, in 10 enteritis, in 3 pneumonia complicated with enteritis and cerebral congestion, and in 1 pleuro-pneumonia."

PROPHYLAXIS.—A patient with erysipelas should be isolated, and the bedding and linen worn by him should be placed in boiling water as soon as removed. No one should be allowed to occupy the bed or room when vacated by the patient until it has been thoroughly disinfected.

TREATMENT.—The external treatment has varied greatly, but those agents are now most employed which have soothing or antiseptic properties. Among them we may mention iodoform in collodion. Trousseau employed an ethereal solution of camphor and tannin. Scarification and leeching, formerly employed, have been abandoned as pernicious, and astringents, as alum and sugar of lead, are now known to be inefficacious. Strong counter-irritation over the inflamed surface has also been practised. Baron Larrey applied the actual cautery, and since his time nitrate of silver, one part to ten, has been used, but without appreciable benefit. The solid nitrate of silver was employed in two cases of which I have the records, and in both the result was pernicious. Troublesome sores were produced, from which blood flowed, and in one of the cases the parents attributed the death to this treatment, rather than to the primary disease. The tincture of iodine is preferable to the nitrate of silver for local treatment. It should be applied in officinal strength over the inflamed surface and to the distance of two inches upon the sound skin. It may fail in arresting the extension of the erysipelas, but it does not produce any unfavorable result. Carbolic acid is a better antiseptic agent for local treatment, solutions of which are known to be absorbed, by the olive color imparted to the urine. It should not, however, be applied in young children over a great extent of surface, on account of the danger of carbolic-acid poisoning. Tillmann and Fehleisen ascertained that cultures mixed with 2 to 4 per cent. of carbolic acid were sterilized. Verneuil sprayed the surface during five minutes every hour with a 2 per cent. solution of carbolic acid. Hueter made hypodermic injections of a 3 per cent. solution of carbolic acid, and found that a syringeful sufficed for two square inches. He employed as many as twelve syringefuls at one time, without, it is said, any unfavorable result; but probably it would be better to limit the number to two or three each day, to avoid the risk of carbolic-acid poisoning. The application may also be made with surgeon's lint constantly saturated with a 2 to 4 per cent. solution of carbolic acid in glycerin and water. Wilde employs, inasmuch as it involves less risk than the use of carbolic acid, one or two syringefuls of an 8 per cent. solution of the sodium sulphocarbolate. It is said that it immediately reduces the temperature, and the erysipelas disappears in three or four days. The use of turpentine externally also has its advocates. Luecke says that when applied upon the erysipelatous surface it reduces the fever and the burning. A mixture of one part of carbolic acid and ten of turpentine has lately been recommended. Nussbaum recommends for external treatment one part of ichthyol to ten of vaseline; and Lorenz, two parts of ichthyol to one part of glycerin and one of ether. Finally, hypodermic injections of corrosive sublimate have been lately used, the solution varying from 1 part in 5000 to 1 part in 500.

On this side of the Atlantic great uniformity prevails as regards the internal treatment of erysipelas. Sustaining measures are prescribed, and the tincture of the chloride of iron is the tonic generally preferred. Whatever the intensity of the febrile reaction and the stage of the disease, if there be no intestinal complication ferruginous or other tonics should be administered. The largest doses of the tincture of the chloride of iron given in any of the cases in the above table were in Case No. 4—namely, ten drops every two hours—and this patient recovered in seven days from a pretty severe attack. Probably, however, nothing is gained by such large doses, and they may irritate the intestinal surface and increase the liability to enteritis, which, we have seen, complicates a certain proportion of cases. Four drops may be given every three hours to a child from one to two years of age. Instead of the iron, or in addition to it, one of the preparations of cinchona may be prescribed.

Erysipelas being an asthenic disease, it is very important that the diet should be highly nutritious and easily digested. Milk, perhaps peptonized, should be given freely, and the various meat peptones are also useful. Brandy or wine is also required. If vomiting be a pronounced symptom it may be necessary to employ rectal alimentation.

PART IV.

SECTION I.

DISEASES OF THE CEREBRO-SPINAL SYSTEM.

DISEASES of the brain and spinal cord are less frequent than those of the respiratory and digestive systems, and, being less amenable to treatment, they largely increase the aggregate of deaths. They contrast with the diseases of the other systems in their greater relative frequency in infancy and childhood than in adult life. This is explained, as regards the brain, by the rapid development and active molecular change in this organ in early life, its great impressibility by the emotions, and the thinness of the covering which protects it from external agencies.

Some of the most important of the diseases of the cerebro-spinal system are peculiar to early life, as tetanus infantum and spina bifida. The diseases of this system also contrast with other local affections in their greater obscurity, especially in their commencement; for, while maladies of the thorax can be readily ascertained by auscultation and percussion, or those of the abdomen by the nature of the evacuations or the degree of tenderness or distension, our means of conducting examination through the bony encasement of the cerebro-spinal axis are meagre and unsatisfactory. The condition of the brain and spinal cord must be determined chiefly by the study of symptoms, and not by direct examination. The state of the anterior fontanel in young infants, however, enables us to determine the presence or absence of active congestion of the brain. If there be an excess of arterial blood, it is convex. Prominence of the fontanel is common in inflammatory and febrile diseases, and is a sign of considerable diagnostic and prognostic value.

Within a few years the ophthalmoscope has been employed as a means of diagnosis in cerebral diseases, and, although the use of this instrument for such purposes is but recent, enough has been elicited to prove its value as an aid in determining the state of the brain. Prof. H. D. Noyes remarks on this subject: . . . . "The argument for making ophthalmoscopic examination in all cases of brain disease becomes irresistible. Indeed, a moment's reflection would lead to this conclusion without any considerations drawn from pathology. The optic nerve is only an outlying portion of the brain; its extremity is fully exposed to view. Situated within about two inches of the brain, it is the only nerve in the body which we can inspect; it contains blood-vessels which communicate directly with the intracranial circulation. We thus come into relation with the cerebrum by continuity of nerve-structure and also of blood-vessels."

Structural changes in the optic nerve and retina have been discovered by means of the ophthalmoscope in meningitis, hydrocephalus, phlebitis of the sinuses, apoplexy, etc. Among the lesions which have been observed by this instrument are hyperæmia, more or less opacity and tumefaction of the optic nerve, engorgement of the vessels of the retina, with serous or sero-fibrinous exudation and ecchymotic points. In certain protracted diseases, as chronic hydrocephalus, in which dimness or loss of sight occurs, the ophthalmoscope discloses a state of atrophy of the optic nerve. Heretofore this instrument has been chiefly employed by oculists, but as it comes into more general use there can be little doubt that it will be recognized as an important aid in the diagnosis of obscure cerebral diseases.

Still, with all possible aid to diagnosis, the obscurity which attends the invasion of many of the cerebro-spinal diseases must be acknowledged. To the hasty and careless physician their symptoms are often deceptive. Careful weighing of the phenomena and thorough and protracted examination are requisite in order to insure correct diagnosis and proper treatment. Some of the cerebro-spinal affections are, in reality, sequelæ of other diseases—as, for example, spurious hydrocephalus—and some are, strictly speaking, only symptoms, as convulsions; but on account of their importance, and because they require special treatment, it is proper to consider them as diseases *per se*.

The brain presents certain peculiarities in infancy and childhood. In the fœtus, while the other organs are well formed, the brain, especially its cerebral portion, is still diffluent, and at birth it has so little consistence that it must be handled carefully to prevent laceration. This softness is due to the large proportion of water which it contains. The following analyses show the composition of the brain in three periods of life:

	Infant.	Youth.	Adult.
Albumen	7.00	10.20	9.40
Cerebral fats	3.45	5.30	6.10
Phosphorus	0.80	1.65	1.80
Osmazome, salts	5.96	8.59	10.19
Water	82.79	74.26	72.51

At birth the brain has a nearly uniform white color. The gray substance, in which the nervous power originates, is undeveloped. The date of its appearance corresponds with the first exhibition of emotion or intelligence, and the decided gray color which we observe in the brain of the adult does not appear until the age of full mental activity.

In the new-born the brain is large in proportion to the rest of the body, and its growth during infancy and childhood is rapid. Until the fifth year, as appears from the observations of Dr. Peacock, its weight is about one-seventh or one-eighth that of the entire system, the proportion varying somewhat in different cases.

The brain does not attain its full size, as stated by Dr. West, at the age of seven years, but, according to Dr. Peacock's statistics, it continues to increase till the age of twenty-five or thirty, although its growth is less rapid after the age of seven years than previously.

The membranous covering of the cerebro-spinal axis is scarcely less interesting to the pathologist than the axis itself. I shall speak in the following pages of the arachnoid and cavity of the arachnoid for convenience of description, although aware of the fact that some eminent authorities, as Virchow and Kölliker, whose opinions in reference to the minute anatomy of the system always command attention, if not assent, believe that there is no arachnoid, but what has heretofore been called by this name is on the one side the smooth surface of the dura mater and on the other of the pia mater.

The dura mater is seldom involved in the diseases of early life, except as it is affected by pressure, while the pia mater and arachnoid are the seat and source of some of the most important diseases, as meningitis, meningeal apoplexy, etc.

The more complicated and delicate the structure of an organ the more liable it is to errors of nutrition and growth. There is, therefore, no organ which is so liable to irregular development as the brain. It may be entirely wanting, or it may be partially developed, certain portions being absent, or, lastly, its growth may be excessive, constituting hypertrophy.

CHAPTER I.

MICROCEPHALUS—ATROPHY OF BRAIN.

An abnormally small brain usually results, according to my observation, from a defect in the fœtal development. At birth the cranium is not only prematurely small, but the cranial bones are firmly united, so that the sutures and fontanels are obliterated. Whether the primary fault has been an exaggerated ossification, so that the brain cannot develop and is compressed, or the development of the brain is primarily arrested from some unknown cause, and the cranial arch consequently does not have its normal expansion, is uncertain. The following are cases of microcephalus as I have usually observed it: In August, 1878, an infant was brought into the Bureau for the Relief of the Out-door Poor with marked microcephalism. Its age was nineteen months, and the bone formation was so slow that only two teeth had appeared; the circumference of its head was fourteen and a half inches; it had had repeated convulsions since the age of five months, and the mother stated that its head had been round and hard from its birth. The following case of microcephalus was brought to the Out-door Department in Jan., 1890: Y——, female, aged fourteen months, was born asphyxiated, and was resuscitated with difficulty. The cranial bones were firmly united at birth, so that the sutures and fontanels were obliterated, and the cranium was unyielding in every part on pressure. Clonic convulsions occurred at the age of one month, and have been frequent to the present time. The infant has internal strabismus, its mouth is open and drivelling, and it is evidently idiotic. Though fourteen months have elapsed since birth, the circumference of the head, measured over the occipital protuberance and the most prominent part of the forehead, is thirteen and a quarter inches, and the distance from one auditory meatus to the other, measured over the top of the head, seven inches. In microcephalus death, sooner or later, is the common result; life ends in convulsions and coma.

Again, the brain of the child when undergoing development, with the cranial bones sufficiently yielding, may not only cease to grow, but may even diminish in size in consequence of protracted and exhausting diseases. Diminution in the size of the brain occurs especially after fevers and diarrhœal affections of long standing and attended with much emaciation. The waste of the brain corresponds with the general loss of flesh. If the cranial sutures be not united, the occipital and sometimes the frontal bones are depressed according to the diminished size of the brain, and are overlaid by the parietal. In foundlings of two or three months this loss of brain-substance is often very striking. In infants of this class who have died of protracted diarrhœa it is not unusual to observe the occipital bone not only depressed, but extending one, two, or even three lines underneath the parietal.

If the child with shrunken brain from protracted and exhausting disease be old enough to express its thoughts, it often seems foolish, talks but little, and perhaps says the same thing over and over again. In one case in my practice a little girl, having passed through a long course of typhus, persistently repeated during her convalescence with a silly smile the questions addressed to her. This peculiarity continued two or three weeks, although her appetite was good and her restoration to health rapid. In another case a little boy during convalescence was wont to laugh heartily at the appearance of the ordinary articles of furniture in the room. Both showed more impairment of mind during convalescence than in the midst of the fever. The friends of such children are in a state of great anxiety lest their minds be permanently enfeebled, but as the appetite and strength return the nutrition of the brain is re-established and the mind regains its former vigor. In cases of wasted brain with cranial bones united the deficiency is supplied by serous effusion, which is gradually absorbed as the health of the patient is re-established and the brain enlarges. This effusion occurs not only over the convexity of the brain, but also at its base, and sometimes in the ventricles. Dr. West states that in atrophy of the brain from protracted disease its texture is firmer than usual. I have not noticed this in infants, but my attention has not been directed particularly to this point. It is probable that there is some change in the anatomical character of the brain aside from mere waste.

Partial atrophy of the brain sometimes also occurs from primary disease located in this organ; the affected portion wastes, while the remainder of the brain has its normal development.

CHAPTER II.

HYPERTROPHY OF BRAIN.

IN contrast with atrophy of the brain is the opposite state, or hypertrophy. The size of this organ within the limits of health varies greatly in different individuals, but sometimes there is so great an increase in volume as properly to constitute a disease. Fortunately, hypertrophy of brain is rare in America.

PATHOLOGICAL ANATOMY.—The excess of growth which characterizes this disease has been ascertained to be confined to the white portion of the brain, and ordinarily to that part contained in the cerebral hemispheres. Hypertrophy of the brain is attended by induration, which exists in different degrees in different cases. It is in some so slight as to be scarcely appreciable, while in others it is apparent at once by pressure with the finger or incision with the scalpel. Rilliet and Barthez state that the induration in some cases resembles in degree and appearance that produced by the action of alcohol. The white substance of the cerebrum is not only resisting and elastic, but its color is unusually pale; it presents even a brillant or polished appearance. At the same time, the gray substance is more or less faded, and its depth in the convolutions is less than in the normal state of the organ. Rokitansky says: "The cineritious matter is generally of a pale grayish-red color. The medullary is always dazzling white and remarkably pale and anæmic." An unusual case is related by Burnet in which the gray substance in the corpora striata retained its usual color and was indurated like the white substance. In exceptional instances the cerebellum as well as cerebrum undergoes hypertrophy, becoming at the same time more or less indurated. In Burnet's case there was induration of the optic nerves. "The internal structure," he says, "of the optic nerves, especially in their bulbs, had the polished homogeneous appearance, elasticity, and almost the hardness of cartilage." Rilliet and Barthez state that in two cases the spinal cord presented even more marked induration than the encephalon. Congestion is not a feature of hypertrophy. On the other hand, there is often less vascularity of the brain and its membranes than in the healthy state. If the cranial bones be completely ossified at the time when hypertrophy commences, and firmly united, enlargement of the brain is partially prevented. The convolutions are then thin, much flattened, the sulci more or less effaced, the membranes pale and dry, and the ventricles are small and nearly destitute of serum. At the autopsy of such a case, when the dura mater is incised the expansion of the brain prevents the proper refitting of the skullcap. Occasionally, hypertrophy causes more or less absorption of the cranium, and perhaps the sutures already united are pressed apart.

If hypertrophy commence in young infants with the fontanels and sutures still open, they usually remain open or are a long time in uniting. The interspaces continue, not only in consequence of the growth of the brain, which tends to separate the bones, but also in consequence of feeble ossification. The shape of the head arrests attention. Hypertrophy usually produces most enlargement between and above the ears, while the frontal portion of the head, though somewhat enlarged, is less developed.

The direction of the eyes is not changed, as is common in congenital hydrocephalus.

Rokitansky says (vol. iii. p. 285): "With regard to the question to be decided by the theory and microscopic examination as to the nature of the added material upon which the increase of volume depends, I have formed the following opinion from repeated investigations:

"1. The disease is genuine hypertrophy;

"2. It consists, as such, not in an increase in the number of nerve-tubes in the brain from new ones being formed, nor in an increase in the dimensions of those which already exist, either as thickening of their sheaths or as augmentation of their contents, by either of which the nerve-tubes would become bulky; but,

"3. It is an excessive accumulation of the intervening and connecting nucleated substance."

It is now generally admitted that the views of Rokitansky are correct—that hypertrophy of the brain is due to an augmentation in the amount of connective tissue which lies between and unites the tubules.

Causes.—Hypertrophy of the brain results from an error in the nutritive process which sometimes seems to be associated with the rachitic state or a condition analogous to rachitis. It is not common—is indeed rare—in this country, and is more common in countries like England where rachitis is more prevalent than with us. Rilliet and Barthez consider frequent congestions of the brain as a common cause. The hypertrophy is most frequently met in hospitals for children and among the poor of cities whose systems are rendered cachectic by residence in damp and dark localities and by unwholesome diet. In the deep valleys of Switzerland and in parts of South Americ and Asia hypertrophy of the brain is common, under the name of cretinism. It is associated with rachitis and stunted growth. The abnormal deve ment which occurs in cretinism begins in infancy or early childhood, and the unfortunate subjects of it are short-lived. Cretinism has been attributed to a residence in localities wet and deprived in great measure of solar light, and to general disregard of the laws of health on the part of those affected, as well as their parents.

The observations of different physicians also establish a connection between some cases of hypertrophy and the saturation of the system by lead. In what way lead-poisoning leads to hypertrophy is obscure, but the concurrent testimony of different observers is so strong that we cannot doubt that it does sometimes have that effect. But in a considerable proportion of cases, as in the one presently to be related, the cause is obscure.

SYMPTOMS.—The symptoms, as is the case with most organic diseases of the brain, vary considerably in different patients. Sometimes there is at first more or less depression or languor. If the child be old enough to speak, he may complain of pain in the abdomen or limbs, evidently neuralgic, or of headache. After a variable time vomiting succeeds, and finally convulsions, affecting the muscles of the face as well as extremities; the convulsions are usually clonic, but sometimes, as regards at least the extremities, of a tonic character. The pupils may be contracted or dilated; there is restlessness alternating with drowsiness, and finally coma succeeds.

Hypertrophy may continue a considerable time before serious symptoms arise; but when once developed these symptoms ordinarily continue with more or less severity till death. Death commonly results within a week after their commencement, but sometimes not till several weeks have elapsed. When death occurs at an early period in the disease, there is usually firm ossification and union of the cranial bones, and therefore but moderate enlargement of the cranium.

If hypertrophy commence at a period not far removed from birth, the bones of course yield more readily to the pressure and acute symptoms do not occur so soon. After a time, however, in all or nearly all cases, convulsions supervene. These indicate the gravity of the disease and are prognostic of its fatal termination.

In a patient observed by Burnet violent convulsions, followed by loss of consciousness, marked the commencement of acute symptoms. Five days subsequently the following symptoms were recorded: mobility of the eyes, without expression; pupils contracted and directed upward; divergent strabismus of the left eye; the senses in their normal state, with the exception of sight; the limbs move by volition. For a month there was little change. Then occurred drowsiness and increased prostration, and five weeks later the child succumbed with the symptoms of double pneumonia.

Such is the clinical history of hypertrophy. In cases of firm ossification of the cranial bones, and therefore no marked enlargement of the skull, the symptoms are similar to those which occur if the dimensions of the head be increased, but compression and death result sooner.

The following case, in which the sutures were firmly united, I attended in 1864. The head was large, but not so large as to attract attention from its disproportion:

CASE.—A boy aged two years and two months had, when about one year old, intermittent fever, and since then his countenance was uniformly pallid and his flesh soft. Weaned at the usual time, he remained well till the 1st of January, 1864. In the beginning of this month he was observed to be feverish for some days and his appetite poor. His health then gradually improved, and he was thought to be entirely well.

On the 26th of February he was suddenly seized with convulsions, general at first, but most severe and continuing longest on the left side. The convulsions lasted a little more than three hours. He recovered fully his consciousness by the following day, but his appetite remained poor; he was no longer amused by his playthings and was very fretful. The surface was pallid; bowels constipated; pulse but little, perhaps not at all, accelerated. He continued in this state till the 6th of March, when he had another slight convulsive attack, and from this time he never fully recovered his consciousness. He was fretful if disturbed, his face generally pallid, while the pulse and respiration were not perceptibly altered.

On the following day, the 7th, the left pupil was somewhat larger than the right, but both were sensitive to light. The difference in size continued till near the close of life. Although vision was imperfect, if not altogether lost, the sense of hearing was not impaired.

When questioned, he uniformly answered, "No," with a drawling voice, evidently not understanding what he said.

As the disease advanced the respiration became at times sighing, but the rhythm of the pulse was not materially altered. The temperature of the surface was changeable, sometimes cool, sometimes warm, and the congested spots or patches, so common in cerebral affections, were also observed at times on the face, ears, or forehead. Through most of his sickness he took drinks readily and the urine was freely discharged, probably from the iodide of potassium, which he took in one and a half grain doses every two hours.

He became more and more drowsy, again had slight convulsive movements, and finally died, with much apparent suffering, on the 14th of March. The pulse became more accelerated during the last two or three days. On the day preceding his death the pupils were contracted and not affected by light.

Sectio Cadav.—Body somewhat emaciated and eyes sunken; occipito-frontal circumference of the head nineteen and a half inches; distance from one auditory meatus to the other over the vertex, thirteen and a half inches; convolutions over the surface of the brain much flattened and compressed; brain generally deficient in blood; medullary substance firm and of a pure white color; meninges healthy; no other abnormal appearances were observed; weight of brain, forty-two ounces. Gowers says that enlargement of the brain occurs under three circumstances: "(1) In very young children soon after birth; (2) Toward the end of the first year of life, in association with rickets; . . . . (3) In older children and adults, but of its nature little is known." He adds: " . . . . It is clear that the pathology of enlargement of the brain needs reconsideration in the light of fresh investigation."[1] It seems to me that hypertrophy of the brain as observed in the cities, where most of the cases in this country apparently occur, is usually one of the manifestations of rachitis, and that the large head of the rachitic is commonly due to an increase in the neuroglia or connective tissue.

DIAGNOSIS.—The diagnosis of hypertrophy is not always easy. The symptoms are, in the main, such as occur in other pathological states, especially congenital hydrocephalus. There is most danger of mistaking the overgrowth for this disease. Hypertrophy has, indeed, often been treated for hydrocephalus. There are, however, certain signs by which we may distinguish one from the other. In the ordinary form of congenital hydrocephalus, even when the amount of liquid is small, the orbital plates of the frontal bones are pressed in such a way that the axis of the eyes is changed so as to have a downward direction. The white of the eye can be seen between the iris and the upper eyelid. This gives a characteristic and striking expression to the face. The exception to this is in those rare cases in which the liquid is external to the brain. In hypertrophy this peculiar change in the axis of the eyes does not occur. Moreover, in hypertrophy there is not that uniform expansion of the head which is observed in hydrocephalus, as has been stated above. There are, commonly, greater enlargement, more prominence of the anterior fontanel, and wider separation of the cranial bones in hydrocephalus than in hypertrophy. But since in some cases of hydrocephalus the sutures are united and the fontanels closed, and there is no change in the direction of the eyes, the reason of the difficulty in making a positive differential diagnosis between these two diseases in certain instances is apparent.

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[1] *Manual of Diseases of the Nervous System*, 1888.

Hypertrophy with consolidation of the cranial bones, and therefore little enlargement of the head, may be mistaken for meningitis. The history of the case and the means by which we diagnosticate the latter affection, which will be described in their proper place, will usually enable the physician to make a correct diagnosis.

PROGNOSIS.—In forming an opinion as to the probable termination of the disease we must have regard to the age and general condition of the child, as well as to the degree of hypertrophy. If the disease commence at an early age, when the cranial bones are not firmly united, it is probable that there will be no compression of the brain, so as to endanger life, for a considerable period. We may then hope by proper measures to remove the constitutional state which gives rise to the hypertrophy, before the enlargement is such as to cause cerebral symptoms. If the bones have already united when the disease commences, even slight hypertrophy will produce symptoms, and a speedily fatal result is inevitable. Evidently, also, a child in a marked degree rachitic or scrofulous is much less likely to recover than one whose general health and constitution are less impaired.

TREATMENT.—The treatment in hypertrophy should be directed mainly to the constitution. Measures calculated to improve the nutritive process are those most likely to check the abnormal growth of the brain. As the disease is one of perverted nutrition, and usually coexists with a vitiated or impoverished state of the blood, tonic and alterative remedies are required. The syrupus ferri iodidi is therefore useful, as it is both tonic and alterative. This may be given in doses of three or four drops, to a child one year old, three times daily. Cod-liver oil, with or without the iron, is beneficial in some cases.

Gowers, although he gives a good description of hypertrophy of the brain in his recent classical treatise on diseases of the nervous system, is silent as regards treatment. In my opinion, the hygienic and medicinal treatment should be the same as that for rachitis, to which the reader is referred.

CHAPTER III.

THROMBOSIS IN THE CRANIAL SINUSES (PHLEBITIS).

THE formation of fibrinous coagula within a vein or sinus is designated thrombosis (*thrombus*, clot). Coagulation of fibrin in the cranial sinuses occasionally occurs, constituting a very serious pathological state. This may result from local disease in the sinuses or in their vicinity or from disease external to the cranium. The immediate cause of thrombosis, whatever its location, is sufficient arrest of the circulation to allow the fibrin to coagulate.

Tubercular and enlarged bronchial glands, compressing more or less the venæ innominata or the descending vena cava, sometimes give rise to thrombosis in the cranial sinuses, the fibrin coagulating in consequence of retardation in the current of blood. I have known thrombosis in the same situation also to result from clonic convulsions, occurring in connection with severe spasmodic cough in pertussis, since both the cough and convulsions retard the flow of blood in the veins and sinuses within the cranium. At the post-mortem examination of at least four such cases I found whitish clots in the lateral sinuses.

Thrombosis in the cranial sinuses may also occur from inflammation, either in the walls of the sinuses or immediately exterior to them. This is the disease which writers have designated phlebitis of the cranial sinuses and for a correct understanding of the morbid anatomy of which the profession are indebted to Virchow.

ANATOMICAL CHARACTERS.—If a child die with the cranial sinuses and the veins of the brain and of the meninges in their normal state, the blood in these vessels is found at the autopsy dark but liquid, or there are small, dark, and soft clots in the larger sinuses. If there were congestion, but no coagulation, in these vessels in the last hours of life, the clots are more numerous, larger, and longer, sometimes extending from the sinuses into the larger veins which empty into them, but they are still dark and soft, readily falling into pieces when handled. If, again, there have been that degree of congestion and stasis which has resulted in ante-mortem coagulation or in thrombosis, the clots are, in part at least, whitish and of a fibrinous or gelatinous appearance; they were formed while the red corpuscles were still carried along in the circulation.

Most of the clots in thrombosis are free, while others are attached lightly to the internal surface of the sinus; occasionally they are so large as to distend the vessel. They extend also in many cases into the cerebral veins which connect with the sinuses, producing prominence and firmness, so as to resemble (Rilliet and Barthez) an artificial injection. The clots do not present a uniform character. In parts of a sinus they consist of almost pure fibrin of a yellowish-white color; in other portions they present a gelatinous appearance from the large number of white corpuscles, while other portions are more or less tinged from the presence of red corpuscles. The central part of the clot after a time, if the case be sufficiently protracted, softens and presents a puriform appearance. The substance, which is only disintegrated fibrin, was supposed to be pus till the microscope revealed its true character. It is obvious that small clots forming within a sinus and having no attachment to its walls are liable to be carried by the current of blood into the general circulation, unless there be complete obstruction. Virchow has also shown how a thrombus may extend, by gradual prolongation, nearer and nearer the heart, so that one commencing in a sinus may after a time reach into the jugular vein. Different observers, as M. Tonnelé and also MM. Rilliet and Barthez, have traced the fibrinous masses as far as the cava. The latter writers relate the case of a girl four and a half years old in whom the sinuses on the left side, especially those nearest the petrous portion of the temporal bone, were completely filled with clots of a yellowish-white color intermixed with central dark spots. Similar coagula were also found in the left jugular vein as far as the brachio-cephalic trunk. Whether the walls of the sinus undergo any change depends on the nature of the disease which causes the thrombosis. If it be phlebitis, the coats are thickened from infiltration and injected and the internal coat has lost its polish. If it be some obstructive disease in the course of the circulation or a general cause, the coats of the vessels are unaltered, except that they may be stained by imbibition of the coloring matter of the blood. In an infant who died of this disease in the practice of Dr. West "the sinuses on the left side were healthy, but the blood was almost entirely coagulated. The posterior half of the longitudinal sinus, the torcular, the left lateral, and the left occipital sinuses, were blocked up with fibrinous coagula, precisely such as one sees in inflamed veins, and the clot extended into the internal jugular vein. The coats of the longitudinal and of the inner half of the lateral sinus were much thickened, and their lining membrane had lost its polish, was uneven, and presented a dirty appearance."

The mode in which congestion and coagulation occur within a sinus in consequence of the pressure of a tumor upon this vessel, or upon a vein into which the blood from this sinus flows, is sufficiently obvious. The mode of the production of thrombosis as a result of clonic convulsions or of the spasmodic cough of pertussis is also apparent. How it results from inflammation of the walls of a sinus—that is, from phlebitis—was not understood till explained by Virchow.

The fibrinous coagula which fill the sinus are not an exudative product, as was formerly supposed. Inflammation (in most cases otitis, with caries of the petrous portion of the temporal bone) approaches a sinus. The inflammatory products pressing against the walls of the sinus diminish its calibre at that point, and hence the retardation of blood and the coagulation. Or the walls of the sinus may be thickened by inflammatory infiltration, or even by the formation of little abscesses within the coats in consequence of the inflammation, so as to produce bulging inward, and the result, as regards the circulation, is the same. Whether, therefore, the inflammation occur without a sinus or within its walls, thrombosis equally results, provided that the diameter of the vessel is sufficiently narrowed by the presence and pressure of inflammatory products.

There is no exudation on the internal surface of a sinus or vein when inflamed, as there is upon serous surfaces. "On the contrary,[1] when the wall is inflamed the exuded matter (exsudatmasse) passes into the wall, which becomes thicker, cloudy, and subsequently begins to suppurate. Nay, even abscesses may form which cause the wall to bulge on both sides like a variolous pustule, without any coagulation of the blood ensuing in the cavity of the vessel. At other times, certainly, phlebitis, properly so called (and in like manner arteritis and endocarditis), is the cause of thrombosis, in consequence of the formation of inequalities, elevations, depressions, and even ulcerations, upon the inner wall, which favor the production of the thrombus. Still, whenever phlebitis, in the usual sense of the word, takes place, the alteration in the coat of the vessel is almost always a secondary one, and, indeed, occurs at a comparatively late period."

This view of the pathology of thrombosis comports with facts observed at autopsies, and which cannot be explained according to the old theory of phlebitis—namely, smoothness of the internal surface of the sinus; natural color of this sinus or simple staining from blood; the non-attachment or slight attachment of the coagula, etc.

CAUSES.—Some of these have been already stated at the commencement of this article. It is evident from what has been said that this disease may be produced by any cause which obstructs the return circulation from the head. I have already alluded to tumors which press upon the sinus or on the vein below the sinus, as a cause. Among the causes may be mentioned also abdominal tumors, narrowing of the chest from rachitis or caries of the vertebræ, and, finally, compression of the jugular vein by a peripharyngeal abscess.

Sufficient allusion has already been made to inflammation of the internal ear as a not infrequent cause. Thrombosis is indeed one of the dangerous results of chronic otitis. Another cause is a reduced or cachectic state of system, apart from any local or obstructive disease. It is a noteworthy fact that a large proportion of those affected with thrombosis, even when it is immediately due to obstructive disease, are cachectic. The explanation of this fact is not difficult. In reduced states of the system the action of the heart is feeble, and passive congestion of the vessels within the cranium is liable to occur. Passive congestion of the veins and sinuses in protracted diarrhœal maladies, which is described in our remarks upon another disease, is an example in point. In this state of feeble circulation very slight obstructive disease may be sufficient to cause thrombosis.

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[1] *Cellular Pathology*, translation, p. 236.

Symptoms.—The symptoms of this disease are often obscure. All of them may and do occur in other maladies of the encephalon. In cases related by M. Tonnelé cerebral symptoms were well marked, such as faintness, dilatation of the pupils, strabismus, grinding of the teeth, convulsive movements. There may be an almost total absence of such symptoms as would direct attention to the state of the head. This is due to the sudden occurrence of death after the clots have formed in the sinuses. If the clots are large, death soon results in consequence of congestion of the brain and meninges, which is proportionate to the amount of obstruction. Extravasations of blood and transudation of serum not infrequently accompany the congestion and hasten the result.

Dr. West relates the case of a girl who had a mild attack of scarlet fever at the age of eight months, and did not fully recover her health. She continued restless and feverish, and had two violent convulsions two weeks after the scarlatina. In the following months she had anasarca, and when she was nearly a year old another attack of convulsions occurred. Fluctuation was now observed in the abdomen, and in a few days a sero-purulent fluid began to escape from the umbilicus. When this discharge had continued eleven days, symptoms of a liquid in the right pleural cavity were suddenly developed. She grew weak and emaciated, and finally was seized with extreme faintness, with which she died in forty-eight hours at the age of thirteen and a half months.

At the post-mortem examination a large amount of pus was found in the abdominal and right pleural cavities. On the right side of the cranium the sinuses were filled with coagula and their coats seemed healthy. The left lateral and occipital sinuses, the torcular, and part of the longitudinal sinus, also contained coagula, which extended into the jugular vein. The walls of the longitudinal sinus and the internal part of the lateral sinus were thickened, and their inner surface had lost its polish and was uneven. There was congestion of the brain, with points of extravasated blood. If, as is probable, the convulsions were due to some other cause, the only symptom which was clearly referable to the thrombosis was the sudden faintness. In the four cases of thrombosis occurring in pertussis already alluded to, in which I was enabled to ascertain by post-mortem examination the presence and extent of the clots, the symptoms, which were apparently due to the thrombosis, were those of cerebral congestion. Among these symptoms stupor, and finally coma, were prominent.

Diagnosis.—It is evident, from what has been said, that thrombosis of the cranial sinuses can rarely be diagnosticated with certainty. The pre-existence of otitis will sometimes lead us to suspect its presence, especially if the otitis have been accompanied by deep-seated pains. Symptoms of cerebral congestion, serous effusion, or apoplexy, occurring in connection with otitis, protracted convulsions, or glandular or other tumors situated so as to compress the vessels which return blood from the brain, indicate thrombosis.

Prognosis.—The prognosis in any case is obviously unfavorable. The cause is, ordinarily, permanent or not readily removed, so that the clots gradually increase. If the cause be a local obstructive disease, death is almost certain, since in nearly every instance the obstruction is of such a nature that

It cannot be removed by medical or surgical treatment. It is possible that recovery may take place if the clots are few and small, and the cause of the thrombosis be mainly feebleness of circulation in consequence of a state of debility. We know that clots may liquefy, and their elements re-enter the circulation; but such a result of thrombosis in a cranial sinus, if it ever occur, is rare. The thrombus by its presence serves as a point of attachment around which more fibrin coagulates, so that the obstruction gradually increases till death occurs.

TREATMENT.—Thrombosis should be treated by cool applications to the head in order to diminish the congestion—by stimulants and sustaining measures in case the systolic movement of the heart be feeble. Tonics, vegetable or ferruginous, are indicated if there be a cachectic state.

CHAPTER IV.

CONGESTION OF THE BRAIN.

CONGESTION of the brain is not peculiar to infancy and childhood, but is much more common in these periods of life than subsequently. This is due, in a great measure, to the fact that in the young the circulation is more readily disturbed by moral as well as physical causes than in the adult.

Congestion of the brain is occasionally primary; more frequently it occurs as a concomitant or sequel of some other affection. Diseases, whether constitutional or local, which in the adult have no appreciable effect on the vascularity of the brain often cause in the child a decided increase of blood in this organ.

CAUSES.—Cerebral congestion is of two kinds, active and passive. The former results from a cause which directly affects the brain and increases the flow of blood toward it, or from a cause operating primarily on the heart and increasing the frequency and force of its systolic movement; the latter is due to some obstruction in the course of the circulation or to feeble propelling power on the part of the heart.

Among the causes which most frequently produce ACTIVE congestion of the brain in the child may be mentioned blows or falls on the head, excessive fatigue or excitement, heat, perhaps sometimes dentition, and also various inflammatory and febrile affections, especially in their first stages.

Cerebral symptoms occurring in the course of an essential fever are no doubt often due, in a great measure, to the irritating effect on the brain of the specific principle, whatever it may be, circulating in the blood. Occurring in inflammatory diseases which are located elsewhere than within the cranium, they are often attributed to functional disturbance of the brain. The brain, it is said, sympathizes with the affected part through the system of nerves which unites them. But observations show that symptoms referable to the brain, arising in the commencement of the essential fevers and of the phlegmasiæ, are in many instances preceded by, and are therefore doubtless in greater or less degree dependent on, hyperæmia of this organ.

Difficult as it is to ascertain the state of the brain in many diseases in which it is involved, we may determine whether or not there be congestion in the young child by observing the anterior fontanel. If it be elevated and tense in an acute disease, hyperæmia is indicated. Now, it is often unusually prominent in fevers and inflammations, especially in their first stages, when cerebral symptoms are present. Its elevation, under such circumstances, is obviously coincident with cerebral congestion.

The acute inflammations which are most likely to be attended by cerebral congestion are those of the mucous surfaces and pneumonia. Severe coryza, tracheo-bronchitis, entero-colitis, and colitis, commencing suddenly with great febrile excitement, are frequently accompanied in their initial stage by active congestion of the cerebral vessels. Cases like the following, which I find in my note-book, are not infrequent: An infant four months old had been sick about two days with coryza and bronchitis when I was called to see it; the pulse numbered 156, respiration 64; it nursed and was somewhat restless; cough frequent and dry; bowels moderately relaxed. The mucous membrane of the fauces was injected, and coarse mucous râles were present in the chest. The anterior fontanel rose above the level of the cranium and pulsated forcibly. Soon after convulsions occurred, which were relieved by appropriate measures, and on the following day the fontanel had subsided. The patient gradually recovered without any untoward symptom.

Cerebral congestion and convulsions often mark the initial stage of active intestinal phlegmasiæ. This is especially true of dysentery. The little patient, perhaps from the very inception of the colitis, is drowsy; its surface hot; pulse full and rapid. There is sudden and momentary starting or twitching of the limbs. The anterior fontanel, if still open, is elevated, and it is not till the lâpse of several hours that the cause of these symptoms is apparent from the occurrence of bloody stools.

The causes of passive congestion of the brain are very different from those of the active form. A common cause is obstruction in a sinus or vein by a fibrinous concretion or by a tumor or abscess external to it.

I have occasionally met cases in which this form of cerebral congestion appeared to be plainly referable to obstruction to the return of blood from the brain by the pressure of bronchial glands, enlarged by hyperplasia in tubercular disease, these bodies diminishing by external pressure the calibre of the venæ innominatæ or the descending vena cava. Rilliet and Barthez have called attention to such cases in the clinical history of tuberculosis. The following case may be cited as an example; it occurred in the infants' service of Charity Hospital in this city in April, 1866:

An infant about one year old, affected with tuberculosis, both bronchial and pulmonary, was observed during the ten days preceding its death to bore the pillow with its head almost constantly, so as to wear the hair from the occiput. The movement of the head was the only prominent cerebral symptom. Nothing abnormal was noticed in the appearance of the eyes, nor was the stomach irritable. A spasmodic cough and progressive emaciation attracted attention, but these were referable to the tubercular disease. At the autopsy we found the cerebral sinuses, veins, and capillaries greatly congested. On tracing the veins which return blood from the brain, an inflamed and enlarged bronchial gland was discovered in the angle formed by the convergence of the right and left venæ innominatæ. This gland, which contained but a single point of cheesy degeneration, had attained such a volume by proliferation of its cells that it pressed upon both vessels, so that it had obviously retarded the circulation in each and given rise to cerebral congestion.

Passive congestion often occurs in the infant at birth, either from tediousness of the labor or delay in the expulsion of the body after the birth of the head. If it be simple congestion, and not congestion with hemorrhage, it soon passes off. Passive congestion of the brain also occurs in severe paroxysms of whooping cough, in which return of blood from this organ is temporarily retarded. All are familiar with the congestion which occurs in parts external to the cranium from the severity of the cough, producing epistaxis, extravasations under the conjunctiva, etc. The extra-cranial congestion obviously indicates the presence and degree of congestion within the cranium.

Those who practise in malarious regions sometimes meet cases of dangerous passive congestion of the brain, the result of malaria, occurring especially in the cold state of intermittent fever. In these cases the surface is pallid, its temperature reduced, and the pulse feeble. The blood, leaving the peripheral vessels, collects in undue quantity in the internal organs, producing congestion of the brain as well as of the thoracic and abdominal viscera. In the child with malarial disease, in whom there is less vigor of constitution than in the adult, death sometimes results from this passive congestion. Two such cases have occurred in my practice, although in this latitude the malarial maladies are mild in comparison with the type which they present in many parts of the United States.

Symptoms.—The symptoms of active congestion of the brain are stupor, great heat of head, throbbing of carotids, restlessness when aroused, twitching of the limbs, and perhaps convulsions. There is also sometimes intolerance of light, and the anterior fontanel, if open, pulsates strongly. In passive congestion many of the symptoms are the same as in the active form. Stupor, twitching of the limbs, and fretfulness or irritability when the patient is disturbed are common, ordinarily without increase of temperature; the surface may indeed be cool and the face is not flushed nor the eyes injected. The strong pulsation and elevation of the anterior fontanel, so conspicuous in active congestion, are—the former always, the latter often—lacking. In both acute and passive cerebral congestion constipation is a common symptom.

In many cases the symptoms of congestion of the brain are associated with others which proceed directly from the cause of the congestion, but it is not difficult, unless in exceptional instances, to determine which are due to the congestion and which to the antecedent and coexisting pathological state.

Anatomical Characters.—In active congestion there is an excess of arterial blood in the brain and its membranes. The arteries, to their minutest branches, are seen to be full, presenting the bright hue of oxygenated blood. In passive congestion the sinuses and veins are distended. The pia mater, choroid plexus, and the vessels of the brain have a darker appearance than in active congestion. In both forms of congestion, unless they quickly abate, other anatomical changes soon occur. If there be great distension of the capillaries, these vessels are liable to give way, and we find here and there little patches of extravasated blood. In other cases the over-distension is relieved by the transudation of the serous portion of the blood through the coats of the vessels. The cephalo-rachidian fluid is then found in excess external to the brain and in the ventricles.

Prognosis.—The duration and the result of congestion of the brain depend, in great measure, on the nature of the cause. If the cause be trivial, as mental excitement, fatigue, exposure to heat, there is usually prompt relief if the condition of the patient be understood and properly treated. If the cause be general or constitutional, as one of the essential fevers or whooping cough, or if it be local, but its seat external to the cranium, the prognosis, so far as the congestion is concerned, is not unfavorable if there be a timely and judicious use of remedies. The most unfavorable cases are those in which the cause is seated in the encephalon and those in which there is some obstructive disease in the course of the circulation. Congestion occurring from a structural change within the cranium is, from the nature of the cause, without remedy and ordinarily fatal. Obstructive diseases of the circulatory system, wherever located, being for the most part permanent, give rise, as a rule, to incurable congestion.

Congestion of the brain, if it be not relieved in a few hours, becomes less and less amenable to treatment. It soon passes beyond the resources of our art and ends in coma; it is seldom protracted beyond a few days. Extravasations of blood, common in active congestion, and serous effusion, common in the passive form, diminish the chances of a favorable result.

TREATMENT.—The indication for treatment in *active* congestion is plain. Measures should be employed which produce derivation from the brain. Unless there be an asthenic primary affection, in the course of which the congestion is developed, active purgation is required. A saline purgative is ordinarily preferable. If the stomach be irritable there is no better purgative than calomel. In all cases of active congestion, whatever the cause, the bowels should be kept open. It is often better not to wait for the tardy action of a cathartic, but to give at once an enema of soap and water or salt and water. External derivative agents are also indicated. A warm mustard foot-bath, sinapisms to the back of the neck or chest and to the feet, and cold applications to the head, are measures which should never be neglected. In many cases those medicines are useful which reduce the contractile power of the heart, as antipyrine, antifebrin, or phenacetin.

This treatment, if employed early, will relieve the congestion in a large proportion of cases; but if there be no improvement, if the child be robust, and if the primary affection be such as does not contraindicate loss of blood, leeches should be applied to the temples or some part of the head. If after the lapse of some hours cerebral symptoms continue, apoplexy or serous effusion has probably occurred. Congestion is then no longer the prominent lesion, and it is proper to designate the disease by another name.

The treatment appropriate for *passive* congestion is somewhat different; cold applications to the head and those of a derivative nature to the extremities are useful. As this form of the disease is not primary, but is dependent on some antecedent pathological state, it is evident that it can only be treated successfully by removing or obviating the cause as far as possible. But the nature of the various obstructions to the intracranial circulation is such that our ability to accomplish this end is very limited.

If the cause be constitutional, or if it be some disease in the neck or chest, it may sometimes be partially or even wholly removed, but if seated within the cranium it is beyond our control. In general, it may be said that depletion is not required or tolerated in passive congestion, and stimulants are often needed.

CHAPTER V.

INTRACRANIAL HEMORRHAGE (MENINGEAL HEMORRHAGE, CEREBRAL HEMORRHAGE).

HEMORRHAGE within the cranium is not very infrequent in infancy and childhood, and there is no part of the encephalon, whether the meninges or brain, in which it does not sometimes occur. If the blood be extravasated upon the surface of the brain or between the meninges, the disease is designated by writers meningeal apoplexy; if in the substance of the brain, cerebral apoplexy. Extravasation may also occur in one of the lateral ventricles. This may, for convenience, be described as a form of meningeal apoplexy.

CAUSES.—Apoplexy is usually (there is an exception) preceded by congestion. If the congestion increase to a certain degree, the distended capillaries give way and extravasation of blood results. Therefore the causes of congestion which have been enumerated in the preceding chapter are, in great measure, those of apoplexy. Recent microscopic examinations have demonstrated that the corpuscular elements of the blood may escape from capillaries without rupture. While, therefore, it is probable that intracranial hemorrhage in early life commonly occurs from rupture, its occasional occurrence through the walls of the capillaries must be admitted.

Intracranial hemorrhage is not infrequent in the new-born. It results in them from tediousness of the birth and severity of the labor-pains. At first there is extreme congestion of the meningeal and cerebral vessels, corresponding with that of the scalp and face. This congestion, continuing, soon ends in extravasation of blood. In some of these cases forceps have been used to effect the delivery, but it is doubtful whether the use of instruments materially increases the congestion or the amount of extravasation. Certainly, in a large proportion of intracranial as well as supracranial hemorrhages of the new-born instruments have not been used. An additional cause of the hemorrhage is, in some instances, the use of ergot, which, by producing strong and continuous pains, interrupts the placental circulation and increases the congestion of the fœtal veins and capillaries.

In infants a few days old intracranial hemorrhage may result from that rapid and fatal disease, tetanus infantum. The hemorrhage is preceded by intense passive congestion, which the tetanic rigidity and spasms produce by obstructing respiration and circulation. Few cases of tetanus infantum occur without more or less extravasation of blood, either meningeal or cerebral. Another cause of this disease is obstruction in the vessels which return the blood from the brain. The various structural changes which produce this obstruction in different cases have been sufficiently described in our remarks on cerebral congestion and thrombosis.

The congestion which precedes hemorrhage, when occurring under the conditions described above, is passive.

Among the causes which produce hemorrhage through the intermediate state of active congestion may be mentioned great mental excitement, of which M. Legendre relates a case, and lengthened exposure to the sun's rays, an example of which Rilliet and Barthez have seen. It is also said that compression of the aorta by an enlarged liver or an abdominal tumor has sometimes produced meningeal or cerebral hemorrhage by causing an increased afflux of blood to the head. A very important cause to which I have not alluded is that general state of the circulatory system which is designated by the term purpura hæmorrhagica. This sometimes results from the antihygienic conditions in which the child is placed. In other instances it results from some antecedent disease, protracted and debilitating, which has produced a profound alteration in the state of the blood and the vessels. The capillaries become less firm and elastic and easily give way, so that in such patients ecchymotic points are ordinarily found in different parts of the system. The diseases which occasionally end in this hemorrhagic diathesis are numerous. I have known it to occur after measles, scarlet fever, and smallpox. It is also an occasional sequel of chronic diarrhœa or intermittent and typhoid fevers, and of rachitis.

ANATOMICAL CHARACTERS.—Hemorrhage in or upon the brain in infancy and childhood differs in important particulars from that occurring in adult life. In the adult, and more so as life advances, the arteries become less detensible and more brittle, so that when hemorrhage occurs it is usually from one of these vessels. In early life, on the other hand, the blood does not ordinarily escape from an artery, but, as has been stated, from the capillaries. The extravasation is not, therefore, so rapid and violent, and is not attended by such laceration and injury of surrounding parts in infancy and childhood as at a subsequent age. In the adult the hemorrhage commonly occurs in the substance of the brain. The flow of blood from the ruptured artery separates the brain-substance, producing a cavity in which a clot forms. This constitutes the usual form of apoplexy in the adult. In the first years of life, on the contrary, the extravasation is commonly from the meninges, and the symptoms to which the effused fluid gives rise are for the most part due to its mechanical effect. Cases of hemorrhage in the substance of the brain constitute a small minority, unless during the days immediately succeeding birth. In early life, therefore, on account of its greater frequency, meningeal hemorrhage is a disease of more importance than cerebral, and its anatomical character should be carefully studied.

In **Meningeal Hemorrhage** the extravasation may be between the cranium and dura mater, upon the visceral layer of the arachnoid, in the meshes of the pia mater, or in a lateral ventricle from rupture of the capillaries in the choroid plexus. Much the most common seat is external to the pia mater in the so-called cavity of the arachnoid; the blood escaping in this situation spreads uniformly in all directions. It soon separates into two portions, the solid and liquid. The solid portion, or the clot, is free or but slightly attached to the adjacent membrane. The meninges in the vicinity of the extravasated blood preserve their normal appearance or are but slightly injected; the clot gradually becomes extended on all sides, so as to form a lamina at the seat of the extravasation, thinner at its circumference than centre, and at first of a dark-red color. The color gradually fades, and the lamina, becoming smooth and polished and at the same time more and more attenuated, finally resembles the arachnoid in appearance. Its diameter varies in different cases from a few lines to two or three or more inches. M. Tonnelé relates two observations in which the adventitious membrane extended over the superior surface of both hemispheres, and in one of them also over the falx cerebri.

The extravasation may occur at any part of the surface of the brain, but its usual seat is the vertex. The next most frequent locality is the base of the brain. The subsequent history of the delicate membrane into which the clot is gradually transformed is interesting. It often extends so as to cover more space than was occupied by the extravasated blood, and its edges are then scarcely distinguishable, in consequence of their extreme tenuity and their close resemblance to the arachnoid. The attachments of this membrane, so far as it forms any, are usually to the parietal surface of the arachnoid. Sometimes a portion of the membrane is attached, while the rest lies free, bathed on either side by the liquid portion of the blood which still remains from the extravasation. According to M. Legendre, in the most favorable cases the serum is absorbed, and the membrane which has resulted from the clot, and which I have described, becomes intimately adherent to the internal surface of the dura mater. It forms an integral part of this membrane, and there only remain a little thickening and increased opacity, indicating the seat of the extravasation. The health is fully re-established.

But the result in other cases is as follows: The serum is not absorbed, and the newly-formed membrane, uniting at points with the inner surface of the dura mater or its arachnoidal covering, encloses the fluid so as to produce a circumscribed hydrocephalus.

Sometimes there is only one cyst; in other instances the membrane, especially if large, unites in such a way as to give rise to more cysts than one. The size of the cyst varies according to the quantity of fluid, which be only a few drachms or several ounces. Rilliet and Barthez report a in which there was a pint of fluid lying over each hemisphere, there two cysts. If the cranial bones are not united, so that they yield to pressure, the size of the cranium is increased, and if the extravasation onfined to one side, an inequality results and the symmetry of the head stroyed. The fluid which causes the enlargement of the head in such s is in part the serum of the extravasated blood and in part a subsequent tion.

arious writers relate cases of ventricular hemorrhage. Valleix met it infant that died at the age of two days. In the *Edinburgh Journal edicine and Surgery*, October, 1831, an interesting case is related. A nine years old died of hemorrhage in both ventricles, and also at the of the brain and in the spinal canal. In the Nursery and Child's Hos- of this city the post-mortem examination was made of an infant who at the age of one month. In the posterior cornu of the left lateral ricle were two clots, elongated and black, one larger than the other. In corresponding cornu on the opposite side was a smaller clot. A similar -mortem appearance was observed at the autopsy of a young infant died in Charity Hospital. A dark crescentic clot lay in each pos- or cornu. The clot, if remaining a long time, undergoes degeneration. he case of an adult in which a year had elapsed after the extravasation I nd it to contain crystals of cholesterin and carbonate of lime.

Cerebral Hemorrhage, or hemorrhage in the substance of the brain, y occur at any time in infancy and childhood. The blood is sometimes ravasated in points here and there over the entire organ or a part of the an ; in other cases it is extravasated in one or perhaps two cavities, as in ordinary form of apoplexy in the adult. In the first form of cerebral orrhage, or that in which the blood escapes from numerous points through brain, there is evidently little laceration or injury of the organ. The in-substance surrounding the hemorrhagic points sometimes preserves the al appearance. It is white and firm. In other cases it presents a reddish yellowish appearance, and is softened to the depth of a line or two. If hemorrhage occur in a cavity, as in apoplexy of adults, the nerve-fibres evidently torn and separated and there is more or less compression of the rounding brain-substance. Unless the disease be of long standing, the ity contains a dark and soft clot bathed with serum which has a reddish a yellowish-red appearance. The brain in the immediate vicinity of the ity is sometimes softened. Rilliet and Barthez state that they have seen ases of cerebral hemorrhage of the capillary form ; 10 cases in which the orrhage was in cavities ; and in 2 of the 18 both forms were present. In those in which the form was capillary the disease was limited to portions he brain, while in the remaining 3 the hemorrhagic points were found in rly every part of the brain.

Apoplectic cavities are seldom seen in the cerebellum, and, whether the orrhage be capillary or in a cavity, there is in most cases, as previously ed, more or less congestion of the vessels of the brain.

The proportion of cases of cerebral to other forms of hemorrhage is eved by some to be greater in the new-born than at any other period of Valleix relates 4 cases of intracranial hemorrhage occurring at this age, which were cerebral, 1 ventricular, and in the other the extravasation in the cavity of the arachnoid. Mignot has published 8 cases occurring e new-born, in 2 of which the hemorrhage was in cavities in the cere- n ; in 3, in the lateral ventricles ; and in 3, external to the brain. If the proportion be observed in other statistics, 1 in 3 of the cases of intra- al hemorrhage occurring in the new-born is cerebral.

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SYMPTOMS.—The symptoms in intracranial hemorrhage are not uniform; they vary according to the seat as well as the quantity of the effused blood. In some cases the extravasation occurs without such symptoms as would direct attention to the brain. When the hemorrhage occurs at the time of birth in consequence of strong and long-continued labor-pains, the infant is often born apparently dead. This is due partly to the hemorrhage, partly to the great congestion of the brain which precedes and accompanies the hemorrhage. Resuscitation is gradual and difficult. The infant's features are livid and perhaps swollen; its respiration is gasping, and both pulse and respiration are slow. Its cry is feeble, with but slight movement of the facial muscles, and the lungs are but partially inflated; the eyelids are closed and the limbs almost motionless. By artificial respiration and by friction the pulse and breathing may be rendered more frequent, but the latter remains irregular and gasping. Finally, the limbs grow cold, the surface, from a state of lividity, becomes pallid, and death occurs in profound coma. M. Cruveilhier made many observations at the Maternité in reference to the death of new-born infants, and he believes that one-third of those who die in birth at the full period die of apoplexy. I have made post-mortem examinations in a few cases when death had occurred from this cause, and in all the hemorrhage was meningeal. One of these was born on the 30th of December, 1864. The birth was delayed by unusual projection of the promontory of the sacrum, so that finally the application of forceps was necessary. The infant was apparently stillborn, but by persistent efforts on the part of the physician who assisted it was resuscitated so as to live several hours, though with constant embarrassment of respiration and with lividity. At the autopsy a large extravasation of blood was found in the cavity of the arachnoid over a considerable part of the convexity of the brain, and the substance of the brain was deeply congested.

Apoplexy in the new-born does not always terminate fatally, or, when fatal, in the sudden manner which I have described. Valleix relates the case of an infant who died of pneumonia at the age of three and a half months. Its birth had been protracted and difficult, but was completed without the use of instruments. It had had during its entire life paralysis of the right side. At the autopsy a clot was found near the base of the right thalamus opticus, evidently existing from birth. Around the clot the brain was softened to the depth of some lines and was of a bluish-red color. A very similar case is related by M. Vernois. An infant lived forty-nine days with paralysis of the left side, and died of pneumonia. At the autopsy a hemorrhagic excavation in process of cicatrization was found behind the right corpus striatum and the thalamus opticus.

Intracranial hemorrhage occurring from accidents of birth is generally attended by marked symptoms, such as have been described. But when it occurs subsequently to birth, whether in infancy or childhood, the symptoms vary greatly in different cases and are generally obscure. I will briefly state the symptoms which have been observed in both the cerebral and meningeal forms of this disease. First, the cerebral. Sédillot relates the case of a child seven and a half years old whose bare head had been exposed several hours to the sun's rays. Suddenly, after a paroxysm of anger, it was seized with great pain, corresponding with the posterior and inferior fossæ of the cranium. It uttered piercing cries and died in a quarter of an hour. A clot was found in the right lobe of the cerebellum. Richard Quinn (Rilliet and Barthez) gives the history of a boy nine years old who in playing with a hoop suddenly stopped, carried his hands to his head, and fell backward unconscious. Three or four hours afterward, when examined, he was found pale, surface cool, respiration slow and at times stertorous, pulse 50 to 60 per minute;

ft arm was flexed, the left leg paralyzed; the right leg and arm con- l; right pupil strongly dilated, the left contracted. He died seven after the commencement of the attack, and a large clot was found centrum ovale on the right side.

lliet and Barthez relate the following case from Campbell: A boy with revious health was suddenly seized about 7 A. M. with repeated vomiting, ed in an hour and a half by violent convulsions; he rolled his eyes and d inarticulate cries; pulse frequent and hard; pupils contracted; trunk wer extremities cool. In the afternoon he presented symptoms of com- n of the brain, such as dilatation of the pupils, frequent and feeble Death occurred in the evening, and a hemorrhagic cavity was found ing the right middle lobe of the cerebrum. Guibert relates a case of sation in the superior part of the right hemisphere of the brain in a urteen years old. The principal symptoms were feebleness of the inability to walk, cephalalgia, involuntary evacuations, fever, grinding eth, rigors severe and prolonged, lividity, loss of intellectual facul- ilatation of the pupils, insensibility to light, stertorous respiration. occurred in about an hour.

liet and Barthez narrate the history of a girl two years old who, after ck of measles, was taken with convulsions accompanied with fever and tion. The convulsive movements affected especially the eyes and upper ities; the right leg was immovable; the left pupil dilated. These ms resulted from hemorrhage in the corpus striatum and opticus us. The same authors relate also the case of a girl seven years old ied with a large apoplectic cavity in the left thalamus opticus. The ms were headache, convulsive movements, loss of consciousness, delir- omiting and constipation, and convergent strabismus. These symp- nearly disappeared, but in a few days the headache returned, with mus and a slight drawing of the face toward the left; on the twenty- h day convulsive movements of the right eye were observed, with sis of the arm. Finally, contraction of the arms occurred, with accele- of pulse, irregular breathing, dilated pupils, paralysis, and retraction head, followed by death on the forty-eighth day.

ese cases, and those from Valleix and Vernois which have been related remarks on hemorrhage of the new-born, are sufficient to show the er of the symptoms in that form of cerebral hemorrhage in which the sated blood forms a cavity in the interior of the brain.

the amount of extravasation be large and the substance of the brain h lacerated and compressed, death may occur almost immediately, and re without symptoms, or before it is possible to determine whether symptoms are present. If the disease be not so speedily fatal the ms, as appears from the above cases, are headache, confusion of t, or even insensibility; cries, sometimes piercing; cold extremities, slow and perhaps stertorous respiration; convulsive movements fol- y paralysis, or convulsions affecting one or more limbs, with paralysis rs; pupils contracted or dilated, sometimes one contracted and the lilated; strabismus, rolling of eyes, vomiting.

se symptoms have all been observed in different cases, but they are present in any one case. Those which are generally present, and on we mainly rely for diagnosis, are headache, convulsive movements, is, confusion of thought, irregularity in the pupils, and strabismus.

the capillary form of cerebral hemorrhage there is usually some ation, so that it is not easy to determine how far symptoms are due hemorrhage and how far to the coexisting pathological state.

re are, indeed, but few published observations of hemorrhage in the substance of the brain unaccompanied with meningeal hemorrhage, hemorrhage into a ventricle, or some other distinct disease; but so far as I have been able to ascertain the symptoms referable to this form of extravasation they are as follows: The child is drowsy; fretful when disturbed; it perhaps moans. There are sometimes slight convulsive movements and partial paralysis. If there be considerable extravasation, the respiration is irregular and sighing. Death occurs in coma, occasionally preceded by convulsions. Taupin relates the case of a child nine years old who died with this form of hemorrhage, accompanied by softening of the brain. The disease began at night with delirium, agitation, and piercing cries. In the morning the patient lay in bed, drowsy, not complaining of pain and not replying to questions; pupils dilated and insensible to light; left eye half open during sleep and its axis changed; eyebrows contracted; face pale; mouth open; had no convulsions, but transient stiffening of the limbs, during which the thumbs were firmly compressed by the fingers; senses unimpaired, but the face drawn to the right; deglutition difficult; pulse small, irregular, and feeble; respiration 32, sighing. In the evening he had rigidity of the limbs and back, and finally was taken with general convulsions, in which he died at eleven o'clock. The hemorrhagic points in this case were numerous. A boy five years old whose case is described by Rilliet and Barthez, died of this disease, pneumonia, and white softening of the intestine. During the last five days there were cerebral symptoms, the chief of which were drowsiness, fretfulness when disturbed, and moaning without apparent cause. Another child, whose case is described by Rilliet and Barthez, died at the age of four years with cerebral capillary hemorrhage, accompanied by yellow softening. Six months before death he had general convulsions, followed by spasmodic movements of the left side. These subsided, but the left side remained feeble.

In **Meningeal Hemorrhage** there are often convulsions, general or partial—in some patients tonic, in others clonic. When partial, the convulsive movements may only occur in the muscles of the face and eyes. With the spasmodic muscular action is a degree of drowsiness with irritability. Paralysis, so common in the apoplexy of the adult, and not infrequent, as we have seen, in the cerebral form in early life, is sometimes, but not ordinarily, present in meningeal hemorrhage. Instead of paralysis, there are vomiting, some febrile action, thirst, and loss of appetite. The symptoms are different, however, according to the exact seat of the hemorrhagic extravasation and the duration of the disease. If the extravasation end in the formation of a cyst, the symptoms are those of hydrocephalus. The following condensed history of cases which I have selected as typical will give us a clearer idea of the history and course of the various forms of meningeal hemorrhage than can be imparted by a narration of symptoms.

M. Tonnelé relates the case of a child who was taken with faintness an convulsive movements. On the following day the trunk and inferior extremities became rigid; deglutition was painful; the pupils were largely dilate immovable; face pale; pulse feeble and intermittent. Death occurred th same day. The dura mater was distended. A layer of coagulated blood o great thickness extended over the convexity of each hemisphere. The vei ramifying into the superior portion of the cerebrum were distended wit coagulated blood. The hemorrhage was in the meshes of the pia mate Drs. Lombard and Panchard of Geneva relate a somewhat similar case. child thirteen months old was convalescing from inflammation of the bro al and intestinal mucous surfaces when it was seized with general convu ; the mouth and eyes were open and the eyes directed upward; pupi d; pulse frequent and irregular. The convulsions abated som soon reappeared with violence. The patient became insensib and died nineteen hours after the commencement of cerebral symptoms. The extravasated blood covered the upper surface of both hemispheres. From the above cases we see the symptoms and the course of meningeal hemorrhage when the extravasation is so large that death speedily results. In protracted cases of meningeal hemorrhage there is either a gradual disappearance of symptoms and return to health, or, circumscribed hydrocephalus occurring, the symptoms of that disease arise.

DIAGNOSIS.—It is evident, from what has been stated, that the diagnosis of intracranial hemorrhage is attended with unusual difficulty, since the symptoms of this disease occur also in other and distinct pathological states. The history of the case, and especially the character of the cause, if ascertained, will aid in diagnosis. If there has been an obvious determination of blood to the brain or some known obstruction to the return of blood from that organ, the persistence of cerebral symptoms would justify us in concluding that either serous or sanguineous effusion had supervened on a state of congestion. The points of differential diagnosis between apoplexy and meningitis are the sudden and full development of symptoms in one case, the gradual commencement and gradual increase of symptoms in the other; differences also of symptoms in certain respects; for example, as regards fever, constipation, etc.

There is one symptom in cerebral hemorrhage which is of great diagnostic value—namely, paralysis. Its presence affords strong evidence that there is extravasation of blood, and probably in a cavity of the substance of the brain. If the extravasation end in the formation of a cyst, the symptoms and appearance of hydrocephalus, which after a time arise, throw light on the nature of the disease.

PROGNOSIS.—There can be no doubt that many cases of intracranial hemorrhage occur and terminate favorably without the nature of the disease being suspected. In such cases the amount of extravasated blood is small or moderate. In several published cases in which the accuracy of the diagnosis was shown by post-mortem examinations, the patients were convalescing from the hemorrhage when they succumbed to intercurrent diseases. If, however, the amount of extravasated blood be such as to give rise to those symptoms which have been described, the prognosis is unfavorable. Recurring convulsions and persistent stupor from which it is difficult to arouse the patient are unfavorable symptoms. If the convulsions cease and consciousness return, even if there be paralysis, the result may be favorable.

TREATMENT.—The proper treatment in intracranial hemorrhage depends on the state of the patient, the time which has elapsed since the extravasation, and the degree of it as shown by the nature and severity of the symptoms. If, as is often the case, the patient be robust and be visited soon after the commencement of the attack, cold applications should be made to the head, mustard to the back of the neck and perhaps chest, and derivation should be produced by mustard pediluvia. In many cases, especially in active congestion, it is advisable to apply leeches to the temple and the bowels should be opened by a stimulating enema. In active congestion also prompt purgation by salines or other cathartics is sometimes of great importance. The object of such treatment is to relieve congestion of the cerebral and meningeal vessels, and thereby prevent further extravasation of blood. If the congestion be active, the pulse continue full and frequent, and the face be flushed, it is proper in many cases to control the action of the heart by a sedative. For this purpose the tincture of aconite-root may be given in doses of one drop to a child five years old, repeated in three hours if necessary, or antipyrine or phenacetin. If the stupor or convulsions continue after sufficient time have elapsed for the patient to receive the full

benefit of the above remedies, more counter-irritation is required. (
ridal collodion should be applied behind each ear. If the hemorrhag
from passive congestion or in a cachectic state of system, active dep
remedies should not be employed. External derivatives are of ser
well as cool applications to the head, and we should attempt, as far a
ble, to remove the cause of the congestion and hemorrhage. If it
on a cachectic state, tonic or other remedies calculated to relieve thi
are indicated. The hemorrhage from such a cause is usually in p
the substance of the brain or in moderate quantity over the surface
organ, and by a timely use of constitutional remedies possibly we m
vent further extravasation of blood and increase the chance of the p
recovery.

If a cyst result from the hemorrhagic effusion, the treatment w
proper is that described in the chapter on Acquired Hydrocephalu

CHAPTER VI.

CONGENITAL HYDROCEPHALUS.

Congenital hydrocephalus consists in an excess of the cerebr
fluid, lying either external to the brain or more frequently in its i
It is due to some vice in the development of the brain or its membr
to a pathological state occurring in them during intra-uterine life. T
ease is in some patients apparent from the symptoms and appearances a
but not always. Occasionally nothing unusual is observed in the s
the head or aspect of the infant till after the lapse of some weeks, w
characteristic physiognomy begins to appear. In these cases the di
still congenital, since there is every reason to believe that the abnorm
to which the excessive production of fluid is due existed from birth.
of arrested or partial development of the brain—as, for example, wh
siderable portion of the hemispheres is absent—there is often an u
large quantity of fluid which serves as a compensation for the lack
I do not regard such cases as examples of hydrocephalic disease,
effect of the fluid is not injurious, but rather useful. I restrict
congenital hydrocephalus to those cases in which the brain is com
if incomplete, the quantity of fluid is more than sufficient to su
deficiency.

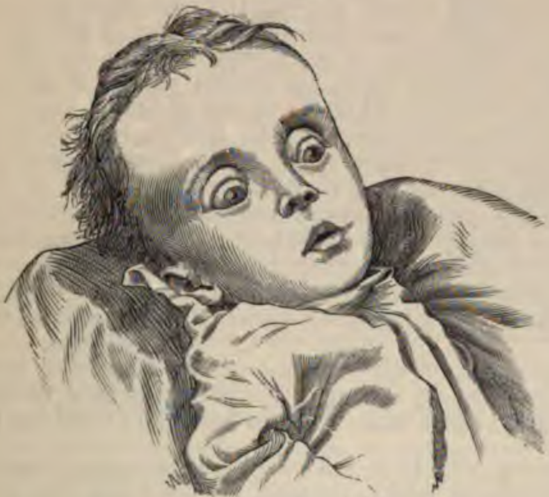
Anatomical Characters.—According to M. Breschet, the flu
genital hydrocephalus may be—1st, between the dura mater and the
2d, between the dura mater and the parietal arachnoid; 3d, in the
the arachnoid; 4th, in the ventricles; 5th, between the arachnoid
brain.

In a large majority of hydrocephalic patients the effusion occu
ventricles. As the quantity of fluid increases the pressure fro
gradually unfolds the convolutions of the brain, at the same time p
expansion of the cranial arch. When the amount of fluid is consi
and it becomes so in the course of a few weeks or months—the he
are spread out in a thin lamina on either side, gradually decreasing
ness from the base of the cranium to the vertex, where the brain-
is sometimes so thin as to be scarcely perceptible. Complete absenc
in this situation—namely, at the vertex, even in extreme cases of

and flattening of the hemispheres from the pressure of the liquid—is rare, though the brain-substance at this point is sometimes almost as thin as either of the membranes, so that the wall of the sac is translucent. The membranes which surround the brain do not usually undergo any alteration, except such as arises from the distension. The falx cerebri sometimes disappears, and sometimes the meninges present a whiter hue from maceration than in health. The distension also causes such an expansion of the pia mater that it becomes very thin, and in places scarcely visible, but its presence in every point can be demonstrated.

The accompanying woodcut represents congenital hydrocephalus as it ordinarily occurs. I saw this infant when it was a few days old, and examined it from time to time till its death. The parents are healthy and have other healthy children. This infant when nine days old began to have clonic convulsions of a mild form in the muscles of the face, neck, and limbs, which occurred almost daily till the age of six weeks, and sometimes every five or ten minutes. When the convulsions ceased in the sixth week the head was observed to enlarge, and its excessive growth continued till death, which occurred at the age of seven months and one week. While the volume of the head progressively increased, the trunk and limbs emaciated. At death the occipito-frontal circumference of the head was nineteen and a half inches; the vertical from auditory meatus to meatus thirteen and a half inches.

FIG. 34.



The changes which the cranial bones undergo, both in their chemical character and in their shape in hydrocephalic patients, if the amount of fluid be considerable, are interesting and remarkable. The base of the cranium undergoes little change, but those portions of the frontal, parietal, and occipital bones which constitute the arch are expanded in all directions, while they become much thinner. There is deficiency of lime in their constitution, so that the organic elements are greatly in excess. This renders them flexible and semi-transparent. Notwithstanding the expansion of the bones, there are usually interspaces between them, of greater or less size according to the amount of fluid.

The scalp, being stretched by the pressure underneath, becomes tense and thin, and is scantily covered with hair. The veins which ramify in it are unusually prominent and large, and the head is elastic on pressure from the amount of liquid beneath. In the common form of congenital hydrocephalus—namely, that in which the liquid is in the interior of the brain—the shape of the orbital plates of the frontal bone is often changed, so that the eyeballs have a downward direction. This change in the axis of the eyes occurs at an early period, and it continues through the entire disease, becoming more and more marked as the quantity of liquid increases. If the amount be large, the lower part of the cornea is buried under the under eyelid, while the conjunctiva is visible between the cornea and the upper eyelid. The persistent downward direction of the eyes is characteristic of this disease, and in connection with enlargement of the head is an important diagnostic sign. Nevertheless, hydrocephalus, even of the ventricular variety, sometimes occurs without change in the direction of the eyes.

If we examine the interior of the cavity after the fluid is evacuated, we will find at its base the parts which lie in the floor of the lateral ventricles, but changed in appearance in consequence of pressure. The cornua are enlarged and the thalami optici and corpora striata are flattened. In the early stages of the disease, when the amount of fluid is small, there is probably no absorption or destruction of parts in the interior of the brain. The various portions of this organ retain nearly their normal relation to each other. As the quantity of fluid increases the foramen of Monro, which unites the lateral ventricles, becomes enlarged, the septum lucidum which separates them disappears, and the two ventricles form a common cavity. In most fatal cases we find this single large cavity. The surface which surrounds the cavity occasionally presents a whitish or semi-opaque appearance, which has led to the belief that at a period antecedent to birth there was subacute inflammation of this surface, and hence the effusion.

The bones of the face are ordinarily less developed than in healthy children of the same age, so that the disproportion between the head and face becomes a marked peculiarity. The shape of the forehead and face is nearly triangular.

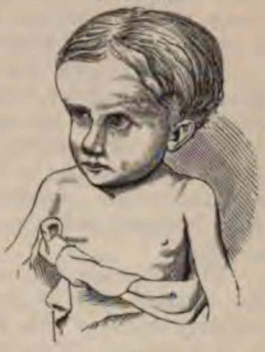
The foregoing remarks in reference to the anatomical characters of congenital hydrocephalus refer in the main to cases which have continued for a considerable time, so that their characteristic features are well marked. In very young infants, in whom the disease is still recent, similar anatomical characters are present, but in less degree.

Congenital hydrocephalus is often associated with other vices of conformation, especially with spina bifida. The two, when coexisting, are only parts of the same disease, the large quantity of cerebro-spinal fluid preventing the spinal canal from closing during fœtal development.

The fluid in congenital hydrocephalus consists largely of water, in the proportion even of 99 parts in 100. In addition to this element there are traces of albumen, chloride of sodium, phosphate and carbonate of sodium, and osmazome.

I have had an opportunity to witness only one post-mortem examination in a case of congenital hydrocephalus in which the liquid was exterior to the brain. This case was under observation in the children's service of Charity Hospital in 1866. Full notes and measurements of the head were taken, which, unfortunately, were mislaid or lost. The infant had congenital syphilis and had a pallid, strumous appearance. The shape and relative size of the head are seen in the woodcut (Fig. 35), from a photograph. While the whole head was enlarged, there was a relative excess of development in the part between and above the ears. The axis of the eyes was not at all changed, and the vision was good. The appearance corresponded so closely with descriptions of hypertrophy of the brain that this was supposed to be the anatomical state. Antisyphilitic treatment was employed, and the syphilitic eruptions had nearly disappeared when diarrhœa supervened, followed by death. At the autopsy a quantity of transparent or light straw-colored liquid, estimated at six or seven ounces, was found exterior to the brain in the great cavity of the arachnoid, lying mostly over the superior surface of the organ. There was no excess of liquid in the ventricles, and the brain, though of good size, was not abnormally large, nor did it possess the firmness which is present in true hypertrophy.

FIG. 35.



All cases of congenital hydrocephalus may be embraced in two groups—namely, that in which the liquid is in the interior of the brain, and that in which it lies exterior to the organ. Liquid primarily in the arachnoidean cavity permeates the meshes of the pia mater, and lies in part underneath it, or this delicate membrane may be ruptured. Four of the groups, therefore, described by Breschet, may properly be reduced to one—namely, those groups in which the liquid lies under, between, or external to the meninges. It is probable that some of the cases which led to Breschet's classification were examples of acquired circumscribed hydrocephalus, the result of extravasation of blood. In this form of hydrocephalus, as is stated elsewhere, an adventitious membrane forms external to the liquid, becoming in time thin and delicate and often bearing a close resemblance to the normal membrane (especially the arachnoid), for which it is sometimes mistaken.

ETIOLOGY.—The constitutional vice which gives rise to this disease is probably different in different cases. I have been able, I think, to attribute correctly a considerable proportion of cases which I have observed to congenital syphilis, but in other instances from the character of the parents I could not assign this cause.

SYMPTOMS.—If there be a considerable amount of hydrocephalic fluid prior to the birth of the child, so that the head is abnormally large, parturition is seriously interfered with. The scalp and meninges may become ruptured by the severity of the pains, so that the fluid escapes. If this do not occur the labor is often necessarily instrumental. Whether the liquid be present before birth or accumulate subsequently to it, the tendency is to an increase of the quantity and a corresponding enlargement of the head.

The digestive function in this disease is at first well performed. The infant nurses readily and has its evacuations with the regularity of other children. Not many weeks, however, elapse, in the majority of cases, before defective nutrition is apparent.

While the volume of the head increases other parts are imperfectly nourished and stunted in their growth. Emaciation of the neck, trunk, and limbs is common, associated with progressive feebleness. In the last stages of this disease there is more or less vomiting, with constipation. If there were previously the ability to support the head, it is now lost and the erect position is no longer possible. In marked cases, when there is great disproportion between the head and the rest of the system, there is frequently not even the ability to rotate the head on the pillow. So long as the cranial bones yield readily to the pressure from within and there is no compression of the brain, the function of this organ is not seriously impaired. The child recognizes its mother or nurse, and it can be amused like other children, though easily fatigued. The state of the senses is different in different cases, and sometimes at different stages of the same case. The sight and hearing in some are perfect, in others impaired, while in others still they are good at first, but gradually become obscured and lost. It is said that the sense of smell may be perverted, so that agreeable odors are unpleasant, and *vice versâ*. Many, reaching the age at which children begin to walk, cannot walk, or if they do it is with a tottering, unsteady gait.

When the liquid increases to that extent—and it usually does sooner or later—that the brain begins to be compressed, dangerous cerebral symptoms arise. The child becomes drowsy and takes less notice of objects. Spasmodic muscular contractions, and finally convulsions, occur. The pupils act feebly or irregularly by light, or one is more dilated than the other. Strabismus also occurs. As death approaches, eclampsia, partial or general, becomes more frequent, and is succeeded by stupor from which the patient cannot be aroused.

The following case, which I copy from my note-book, is an example of the common form of congenital hydrocephalus; it will give an idea of the ordinary course of this disease, and show the difficulty which we meet with in its treatment: Female, born November 9, 1859, with the aid of forceps. At birth the fontanels were unusually large, the cranial bones separated, and the aspect in a marked degree hydrocephalic. She nursed at first, but, the mother's milk failing, she was afterward bottle-fed. At the age of four months her head, which had increased faster than her general growth, measured from one auditory meatus to the other, over the vertex, seventeen inches; the occipito-frontal circumference, twenty-three inches. At this time she manifested considerable intelligence, being able to distinguish her mother from other persons, though the head was so large that it was necessary to support it constantly on a pillow. From the age of four to six months the operation of tapping was performed six times with a small hydrocele trocar by Dr. Stephen Smith, at a point near the coronal suture and from one inch to one inch and a half from the sagittal. At each operation an amount of fluid varying from twelve ounces to one pint was removed, and the head then covered with strips of adhesive plaster, so as to form a complete cap. It was necessary, however, within the twelve hours succeeding each operation to loosen the dressing on account of either the occurrence of convulsions or symptoms premonitory of them. The head within a week subsequently to each operation regained its former size, and, as there was no permanent benefit, this treatment was discontinued. She finally died of entero-colitis at the age of ten months and five days.

At the autopsy the distance from one auditory meatus to the other was twenty and a quarter inches; the occipito-frontal circumference, twenty-six and a quarter inches. The anterior fontanel measured antero-posteriorly four and three-fourths inches; transversely, seven and three-fourths inches. The parietal bones were separated from each other to the distance of two or three inches, and they measured in length nine and a half inches.

On opening the cranial cavity, seven pints, by measurement, of transparent fluid escaped, exposing a vast open space at the bottom of which were the parts which constitute the floor of the ventricles, somewhat changed in shape, and from them on either side the hemisphere was spread in a lamina, so as to cover the internal surface of the cranial bones. The laminæ near the base of the brain measured in thickness from half an inch to one inch, and they gradually became thinner on approaching the vertex, at which point the brain-substance was exceedingly thin, so as to be scarcely demonstrable.

The brain had its normal vascularity and consistence, and the cerebellum, medulla oblongata, the base of the brain, and cranial nerves presented their usual appearance. On folding the brain together it had the size, shape, and aspect of this organ in its ordinary development. Nothing unusual was observed in the membranes except their great expansion. The above case corresponds in its general features with most cases met in practice.

DIAGNOSIS.—The ordinary form of congenital hydrocephalus, that in which the liquid occupies the interior of the brain, can in most cases be readily diagnosticated. If there be only a moderate amount of liquid, it may be confounded with hypertrophy of the brain. In hydrocephalus there are commonly more rapid growth and greater expansion of the head; moreover, the enlargement occurs equally on all sides, while in hypertrophy, though all parts of the cranial vault are expanded, the enlargement is more at the vertex than elsewhere. The hydrocephalic head yields more readily to pressure than the hypertrophied, and often communicates a fluctuating sensation. Moreover, in the ordinary form of hydrocephalus the change in the axis of the eyes described above is an important diagnostic sign. In rachitis the volume of the head is often considerably enlarged, due sometimes, in part at least, to a deposit of calcareous matter on the exterior of the cranial bones. The differential diagnosis is based on the shape of the head, round in one, square or with prominences in the other, on palpation, direction of the eyes, etc. The smaller the amount of liquid, the greater the liability to error of diagnosis; but if the amount be inconsiderable and not increasing, little treatment is required except hygienic and tonic, which is also proper in both hypertrophy and rachitis. If the liquid be exterior to the brain, as in the case represented in Fig. 35, diagnosis may be difficult, but such cases are infrequent.

PROGNOSIS.—In the majority of cases this is unfavorable, since the secretion of liquid usually continues. The most favorable result is no increase, or but slight, in the quantity, while the natural growth of the infant increases, and thus the disproportion between the head and the rest of the system gradually disappears. Such patients may live to maturity and have tolerable health, and may engage in occupations. But ordinarily in cases left to themselves, and even in a large proportion of those having the best treatment, the body and limbs gradually waste from defective nutrition, and the patient, if not cut off by an intercurrent disease, finally succumbs with cerebral symptoms produced by pressure of the liquid. Probably more than half of the hydrocephalic patients die before the close of the second year.

TREATMENT.—We may attempt to diminish the quantity of fluid by the use of diuretics. Digitalis, squills, nitrate and acetate of potassium have been used. The most efficient diuretic in these cases, however, is the iodide of potassium. This may be given in doses of one to two grains every two hours to an infant of three months. Constipation, if present, should be relieved by an occasional purgative. If it be tolerated, we may partially prevent the expansion of the head by a close-fitting cap. For this purpose strips of adhesive plaster about one-third of an inch in width should be applied so as to cover the entire head. The proper way of applying these is as follows: First, one strip from each mastoid process to the outer part of the orbit on the opposite side; secondly, from the back of the neck, along the longitudinal sinus, to the root of the nose; thirdly, over the whole head, so that the different strips will cross each other at the vertex; and, lastly, a strip long enough to pass three times around the head should be applied, passing above the eyebrows, the ears, and below the occipital protuberance. Too tight an application should be avoided, as it may give rise to convulsions or other cerebral symptoms. If the cap can be tolerated and the general health be good, the prospect is more favorable; but usually, from the increase in the quantity of fluid, it is necessary in a few days to remove or loosen the strips in order to prevent convulsions, or, which is preferable, to diminish the size of the head and relieve the pressure by tapping. In 56 cases collected by Dr. West in which tapping was employed, 4 recovered. The operation is simple, easily performed, devoid of danger, and it frequently gives temporary relief. It should therefore be recommended to the parents, even if it do not effect a cure. It should be performed by a very small trocar, which should be introduced in the coronal suture, about an inch external to the anterior fontanel. A few ounces should be removed, and strips of adhesive plaster or an elastic skull-cap applied. In a few days the operation should be repeated as the liquid increases. It is important to maintain compression of the skull before and after the operation (Treves). Sometimes a dozen or more tappings are required at intervals of a few days or weeks, when the secretion may come to a standstill. In the *Med.-Chir. Trans.* (1864) a case is related in which two tappings effected a cure, but so good a result is exceptional. Iodine injections in connection with tapping have so far not produced any satisfactory result. Sir James Paget[1] relates a case in which he injected ten grains of iodine and twenty grains of iodide of potassium in one ounce of water, but the child died of convulsions after the second injection. No appreciable good result has followed the use of irritating or sorbefacient applications to the head. Nutritious diet and attention to the general health are requisite.

CHAPTER VII.

ACQUIRED HYDROCEPHALUS.

HYDROCEPHALUS, or dropsy of the brain, may also occur in those who at birth are well formed and free from disease. Pathologists call this acquired hydrocephalus. It is in nearly all cases the result of disease, which is located sometimes within the cranium, but often in other parts of the system.

CAUSES.—The diseases within the cranium which most frequently produce serous effusion are the meningeal inflammations, both simple and tubercular, tumors or other causes which obstruct the venous circulation, and hemorrhagic effusion ending in the formation of cysts. Prolonged passive congestion often ends in transudation of serum through the coats of the capillaries. Therefore, all causes of congestion, except such as have a transient or momentary effect, may be regarded as causes of serous effusion. In rare instances chronic hydrocephalus results from cerebro-spinal fever (meningitis), as has been stated in my remarks on the latter disease.

Among the diseases external to the cranium which produce serous effusion within or upon the brain may be mentioned retropharyngeal abscess, tuberculization or inflammation of the bronchial glands, scarlet fever, and certain affections of an exhausting nature, especially protracted diarrhœal maladies. In at least five cases which have fallen under my notice, and in which post-mortem examinations were made, the cause was enlarged tubercular bronchial glands, which, by pressure on the venæ innominatæ, so retarded the flow of blood from the brain as to cause congestion and effusion. The causal relation of these glands to cerebral congestion is described in our remarks in reference to this disease.

[1] Medical Times and Gazette, 1860.

Dropsy of the brain is common in protracted infantile diarrhœa; as, for example, in advanced cases of intestinal catarrh of the summer months in the cities. It is preceded and accompanied by passive congestion of the cerebral veins and sinuses, due in part to feebleness of circulation in consequence of the exhausted state of the patient, and in part to wasting of the brain, which always give rise to more or less passive congestion, unless in young infants, in whom the cranial bones become depressed and override each other. Dropsy of the brain, resulting from scarlet fever, and that peculiar circumscribed dropsy which results from hemorrhagic effusions, are described elsewhere.

A few cases have been related by different observers, Abercrombie among others, in which dropsy of the brain seemed to be essential. Nothing abnormal was observed, with the exception of serous effusion. But the reports of such cases are, for the most part, meagre, and, as Barrier has well said, we are not to accept such cases as examples of essential dropsy of the brain unless the post-mortem inspection be so complete as to render it certain that there was no pathological state which might cause the dropsy.

Anatomical Characters.—Acquired hydrocephalus usually occurs after the cranial bones are firmly united, and therefore the shape of the head is not materially altered. If it occur at any early age, before there is free union, there may be expansion of the cranial arch, as we sometimes observe in the circumscribed hydrocephalus resulting from hemorrhage. The effusion in acquired hydrocephalus occurs over the surface of the brain, in the subarachnoid space, or in the lateral ventricles. In the dropsy of protracted diarrhœal maladies I have rarely failed to find the liquid over the whole superior surface of the brain as well as at its base.

The quantity of fluid in this disease is not large. In the majority of cases it does not exceed four ounces, and is often much less. It is transparent or it has a slightly yellowish tinge. The membranes of the brain sometimes present their normal appearance, but in other cases they are injected. The brain itself in some instances has an injected appearance from passive congestion of the veins and capillaries; but in others, when there has been more or less compression of the brain, there is no more than the ordinary, or even less than the ordinary, vascularity, and the convolutions are somewhat flattened.

Symptoms.—The symptoms of the pathological state which gives rise to the dropsy precede and accompany those which are referable to the dropsy itself. The dropsy declares itself by symptoms which are alarming from the first.

In children old enough to speak or manifest intelligence there may be at first complaint of headache. The child is irritable, its mind confused or wandering at times, or there is actual delirium. After a time drowsiness occurs. The head seems too heavy for the body and is buried in the pillow. In fatal cases the features become pallid, the pupils sluggish, and perception and consciousness are gradually lost. The child lies in profound sleep, which increases. There are now often convulsive movements, partial or general, and these soon end in coma, in which the patient dies.

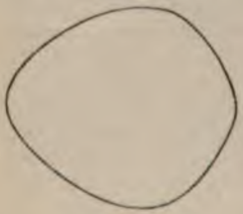
The following was an interesting case of acquired hydrocephalus which seemed to result from subacute meningitis. The patient was seen by several physicians, and the diagnosis was for a long time doubtful:

Harry R. L——, of healthy parentage, was well till the summer of 1876, when he was nearly at the close of his third year. At this time he was observed to be feverish and fretful and his features were flushed at times. He also complained almost daily of pain in the top of his head, which pain *was intermittent*, and these attacks of headache occurred during at least six months, perhaps longer. There had been no backwardness in dentition and no symptoms of rachitis or struma, and his nutrition was good even after the commencement of the present malady.

In February or March, 1877, his stomach became irritable, so that he vomited often during the following months, and about the same time he began to lose the use of both legs—a progressive paralysis—and his bowels became constipated. Both urination and defecation were sluggishly performed. In July, 1877, he ceased to walk, and he has not been able to stand since.

On March 29, 1878, the following records were made: No improvement, but gradual increase of most of the symptoms; lies constantly; moves his limbs slowly and infrequently, but completely, and sensation appears to remain in all of them; his eyes are clear and his pupils moderately dilated, but without vision—how long his sight is lost is not known; axis of eyes not depressed or otherwise changed, and parallelism retained; the cranium, which during the first year of his sickness underwent little change, has expanded rapidly during the last six months; the enlargement is most marked above the ears; the occipito-frontal circumference is represented in the accompanying diagram; this circumference measures twenty-one and a half inches, of which nine and three-quarters are in front of ears, and eleven and one-third inches posterior to ears; distance over vertex from one auditory meatus to the other, fifteen and a quarter inches. The anterior fontanel is observed to be open, though small, the diameter being about one-fourth or one-third of an inch; it is not elevated and the surrounding edge of bone is flexible.

FIG. 36.



This patient lived till near the close of 1880 without material change in symptoms, and with moderate progressive increase in the size of the head. At the autopsy measurements were again made, but they have been mislaid. The enlargement was found to be due to the presence of about three pints of straw-colored serum in the lateral ventricles, which had been changed into a large cavity. There was nothing to indicate any other disease. From the history and appearances we inferred that the hydrocephalus had been due to a mild meningitis occurring in the third year. The appearance and state of the encephalon were precisely like those in ordinary congenital hydrocephalus.

In January, 1890, I exhibited to the New York Pædiatric Society a child with acquired hydrocephalus which dated back to an attack of cerebro-spinal fever of mild type which occurred a few months previously. It seems to me that the case detailed above resulted from the same disease.

PROGNOSIS.—Acquired hydrocephalus commonly ends unfavorably. The prognosis depends not only on the quantity of liquid, but on the nature of the cause. If the cause be venous obstruction within the cranium or thorax, death is inevitable, since we have no means of removing it. If it be an exhausting disease, as entero-colitis or scarlet fever, although the case is not absolutely hopeless, the prospect is still unfavorable. It is only favorable when the quantity of effused fluid is small, the system not much reduced, and the primary disease mild. When acquired hydrocephalus arises from meningeal apoplexy, the case is usually chronic. The symptoms and termination of this form of the disease are very similar to those in congenital hydrocephalus.

TREATMENT.—The treatment in acquired hydrocephalus must vary somewhat in different cases, according to the nature of the disease on which it depends. I shall indicate the treatment, in part at least, in the description of these diseases. Occasionally the condition of the patient is such that there is little to encourage us in the employment of any remedial measures. In vigorous children, if acquired hydrocephalus occur in connection with symptoms which indicate too active a circulation, moderate abstraction of blood from the temples at an early period may be useful, but cases requiring such depletory measures are rare. These cases require cold applications to the head; the bowels should be opened, and derivatives should be applied to the feet and back of the neck.

If the congestion be of a passive character, as when the circulation is obstructed by tumors or otherwise, benefit may still be derived from cold applications to the head and derivatives to other parts. In most cases of suspected dropsy of the brain, unless the patient be in such a hopeless state that all treatment is obviously futile, vesication should be produced behind the ears. I prefer cantharidal collodion for this purpose. In addition to this treatment, diuretics should be employed, unless there be too great prostration or the course of the disease be so rapid that no benefit can result in consequence of the tardy action of these agents. The best diuretics are the acetate of potassium and iodide of potassium.

CHAPTER VIII.

MENINGITIS (TUBERCULAR AND NON-TUBERCULAR).

THE most interesting and important disease of the cerebro-spinal system in early life is that which is now designated meningitis. It is not infrequent. The mortuary statistics of this city show that it is the cause of death in from 1 in 25 to 1 in 50 of the entire number of deaths, the proportion varying somewhat in different years.

In 1768 the attention of the profession was particularly called to this malady by Dr. Whytt of Edinburgh. This observer and the pathologists succeeding him, forming their opinion of meningitis from its most prominent anatomical character—namely, serous effusion—believed it a dropsy. They accordingly designated it acute hydrocephalus. During the last half century the profession have come to regard the disease as inflammatory, and hence the name by which it is now known and which is believed to express its true pathological character.

Sometimes meningeal inflammation in children occurs without tubercles. In other instances it results from the presence of tubercles, and in most if not in all such patients there are tubercles in or under the meninges, which excite the inflammation in the same manner as in the lungs they cause pneumonitis or pleuritis. Therefore two forms of meningitis are recognized—to wit, tubercular and non-tubercular. Meningitis is also, as we have seen, the characteristic anatomical character of cerebro-spinal fever, but as this is a general disease, with the meningitis as a local manifestation, we have treated of it at length among the constitutional maladies.

In patients over the age of eighteen months, although the proportion of tubercular to non-tubercular cases is larger than under this age, the excess is not so great, according to my statistics, as the remarks of some observers lead us to suppose. There can be no accurate statistics of tubercular meningitis without careful post-mortem examination of the state of the brain and other organs in each supposed case, and this examination sometimes shows the meningitis to be non-tubercular when the symptoms and signs had indicated its tubercular character. As an example may be mentioned a case which occurred in the children's service of Charity Hospital in March, 1868. The infant died at the age of twenty months, having had a cough of moderate severity at least three weeks before death, and symptoms of meningitis about four days. It was considerably wasted, and was supposed to have tuberculosis. At the autopsy no tubercles were found in any part of the body, but portions of both lungs were hepatized. A fibrinous deposit, varying in thickness, was found over the pons Varolii, the optic commissure, along the fissures of Sylvius, over the superior surface of the anterior half, and also upon the superior lobe of each cerebral hemisphere. As the examination failed to discover any tubercles, the meningitis was considered non-tubercular. Those who make these examinations, failing to find tubercles in the lungs and other organs in which they usually occur, should examine the lymphatic glands, since cheesy glands may be the cause of the formation of tubercles in the meninges, while the organs of the trunk remain unaffected. The presence of cheesy glands in the absence of visceral tubercles, and with granulations upon the meninges, small, covered with fibrin, and of a doubtful character, goes far toward establishing the tubercular nature of the meningitis. Since the cases embraced in the following statistics were observed, now more than twenty years, I have been led by a more extended experience, and especially by the observations of cases in the New York Foundling Asylum, where there is ample material, to regard not only the presence or absence of tubercles, but also of caseous substance, as the proper test of the form of meningitis. Not a few that seem at first to have non-tubercular meningitis will be found, on more thorough examination, to have caseous substance in some part, the result of a pre-existing inflammation; and if we regard the inflammation of the meninges occurring under such circumstances as tubercular, the relative proportion of tubercular cases will be considerably augmented. The following is an example: When on duty in the asylum in August, 1881, an infant one year old died of meningitis. No tubercles were observed in the fibrin at the base of the brain and along the fissures of Sylvius, but one inflammatory nodule (cerebritis) as large as a chestnut, with suppuration inside, was found at the summit of one hemisphere. No tubercles could be detected in any of the organs of the trunk, unless a few whitish spots in the spleen were of this nature, but the bronchial glands were cheesy and softened, and the middle lobe of the right lung also contained cheesy substance. It seemed to me probable that some of this degenerated product taken up by the vessels had lodged in the meninges and produced the tubercular neoplasm there which was hidden under the fibrin. (See chapter on Tuberculosis.)

AGE.—The following table gives the age in meningitis, tubercular and non-tubercular, in forty-two cases in my collection, which of course is only a small proportion of those which I have observed; but these are the only cases of which I have preserved notes which are now accessible:

Cases.	Age.
1	2½ weeks (autopsy).
2	3 months.
20	From 3 to 12 months.
10	From 1 year to 2 years.
5	From 2 years to 5 years.
4	Over 5 years.
42	

Rilliet and Barthez have also published statistics of the age in meningitis.

Their cases were observed chiefly in hospital practice, and the result is somewhat different. In 32 cases of non-tubercular meningitis observed by these authors, 8 were under the age of one year, 6 from two years to five, and 18 over the age of five years. In 98 cases of tubercular meningitis, 2 were under the age of one year, 51 between the ages of one year and five, 38 between the ages of five years and ten, and 7 between ten and fifteen years. Gowers states that the age at which meningitis is most frequent is between the first and tenth years.

PATHOLOGICAL ANATOMY.—This differs considerably in different cases. The dura mater is usually unaffected or is affected secondarily. In many cases it retains its normal appearance, its internal surface remaining smooth and polished, while in others it is more or less injected and its internal surface dim or lustreless. The free surface of the pia mater, formerly designated the visceral arachnoid, is in a great part of its extent unchanged, but is often hyperæmic or dry and cloudy or opaque over the seat of inflammation. Exudation does not occur upon the free surface of the pia mater, however intense the inflammation.

In meningitis, tubercular and non-tubercular, the inflammatory action occurs in the pia mater. In its meshes or underneath them those lesions result which characterize the disease, and to which other lesions are secondary. Tubercular meningitis is most frequently basilar, or is basilar chiefly and primarily, although the inflammation may extend along the sides of the hemispheres. The meningitis is ordinarily most intense around the pons Varolii, in the subarachnoid space, and along the fissures of Sylvius, for the tubercular neoplasm occurs chiefly at the base of the brain and along the vessels. In non-tubercular meningitis the inflammation may also occur at the base. It may in young infants be quite diffuse, and of little intensity in any one place, producing, in addition to hyperæmia of the pia mater, slight cloudiness and a moderate or slight escape of leucocytes from the blood, these (pus-cells) being perhaps visible only under the microscope. In meningitis due to extension of inflammation from an otitis media the inflammatory action is intense, confined to the portion of the meninges nearest the ear, and is often attended by inflammation of the adjoining brain-substance, with perhaps the formation of an abscess. If the cause be exposure to the sun's rays or traumatism, the meningitis is usually at the summit of the brain.

The exudation of fibrin is greatest along the course of the vessels and in the depressions between the convolutions, and the opacity is most marked in these situations. Pus, when present, is often semi-solid, from the small proportion of liquor puris which it contains, even in recent cases. If the disease have continued several days, the liquor puris may be mostly absorbed, and the pus-cell, becoming shrivelled, irregular, and aggravated, may resemble closely the cheesy transformation of tubercle-cells.

The fibrinous exudation presents features of interest. It does not usually attain much thickness, but by its opacity it conceals from view the brain underneath. If it occur in the fissures of Sylvius, the anterior and middle lobes are united by it. It is usually infiltrated through the substance of the pia mater. Sometimes little masses of variable size, often not as large as a pin's head, appear at the point of inflammation. These masses are firm, of a whitish color or a light yellow, and their number varies in different cases. They consist of a firm, homogeneous substance containing granular matter and cells which often bear a close resemblance to tubercle-corpuscles, but are distinct. These corpuscular bodies are plastic nuclei or plastic cells, often shrunken. It is seen, then, that there are two morbid products which may be mistaken for tubercle—one, pus which has been in great measure deprived of its liquid element, and which may resemble cheesy tubercular matter; the other, plastic nuclei collected in little bodies, so as to resemble the ordinary form of crude tubercle. I once carried to one of the best microscopists and pathologists of this city some of the exudation from a case of meningitis, the cellular element in which could not readily be distinguished from shrunken tubercle-corpuscles. The exudation was from a child two years and eight months old, with good health previously to the meningitis, without tubercles in any part of the body, with parents healthy, and with no predisposition to tubercular disease. The microscopist, not knowing the history of the case or character of the family, and ignorant, like all of us at that time, of the true tubercle-cell, pronounced the exudation tubercular after a careful examination with the microscope. Bouchut says: "The whitish miliary granulations which are observed on the surface of the pia mater have a certain consistency and tenacity which render them difficult to tear with the needles used for the preparation for the microscope. These bodies are formed—1. Of fibro-plastic elements, whether nuclei or fusiform fibres; oval-shaped cells are generally present, but not always. The nuclei are oval or spherical, generally very small—that is to say, they hardly exceed in diameter 0.008 mm. to 0.009 mm. The presence of these little spherical nuclei must be insisted on, because with a less power than 550 diameters it would be sometimes impossible to establish the differences which separate them from the elements of tubercles; the fusiform fibres are small and rare. 2. There exists a considerable quantity of amorphous homogeneous matter in which minute granulations are scattered; it is very dense, and keeps the other elements strongly united together, so that it is difficult to isolate them completely. 3. Vessels are very rarely observed; the fibres of connective tissue are also rare or altogether wanting."

In the tuberculosis of young children I have found in a large proportion of cases in which I have had an opportunity to make post-mortem examinations miliary tubercles disseminated through the lungs and perhaps other organs in small masses, many of them not larger than a pin's head, and some occurring as mere specks scarcely visible. These minute tubercular formations have ordinarily been semi-transparent, and sometimes even transparent like minute drops of water, and containing the true and unchanged tubercle bacillus. Now, if in such a case meningitis occur, we may find the tubercle-cell in or with the fibrin at the base of the brain. But failure to find it, even with protracted microscopic examination, does not prove its absence from this locality, for I consider it almost impossible to discover in the midst of the fibrinous exudation such minute points of tubercular matter as are seen in the lungs, liver, or elsewhere.

The pia mater is often firmly adherent to the brain at the seat of inflammation, so that on raising it a portion of the brain may be detached and removed with it. The extent of the inflammation varies much in different cases. There may in extreme cases be pretty general inflammation of the pia mater. In cases of such extensive meningitis the symptoms are usually severe and the course of the disease rapid. Thus, in the month of April, 1866, a girl eleven years of age, in the Protestant Episcopal Orphan Asylum of this city, had complained occasionally of dizziness, but was otherwise in good health, cheerful, and with excellent appetite, till Thursday, when she was effected with vertigo, more persistent than previously, and with headache. At 2 P. M. on the following day she was seized with general convulsions, and continued insensible or nearly so, with occasional convulsive movements, till Monday, when she died comatose. The pia mater at the vertex, sides, and base of the brain had a cloudy appearance, and underneath it in places was a thick, creamy substance in small quantity, which, examined by the microscope, proved to be pus, the largest amount being near the pons

ii. There was no tubercle under the meninges or elsewhere, and no
ciable fibrinous exudation. The meningitis, though of brief duration,
early general. The only additional lesions noticed were moderate con-
n of the brain and an increase in the quantity of the cerebro-spinal

the disease be protracted three or four weeks, which is rare, or even
ime, the exuded substance may undergo further changes, such as occur
ple exudations in other parts of the system. Thus, on the 30th of
1860, we made the post-mortem examination of an infant at the Nurs-
d Child's Hospital who had symptoms of cerebral disease, it was stated,
veral weeks, but the exact time was not ascertained. Prominent among
mptoms referable to the cerebro-spinal system toward the close of life
he hydrocephalic cry and rigidity of the neck. The appearance at the
y was remarkable. The anterior half of the brain was completely
d in a deposit which had nearly the appearance of lard. It filled the
s of Sylvius and appeared slightly on the anterior aspect of the cere-
a. Examined under the microscope, this substance was found to con-
numerous cells, among which could be distinguished some resembling
ells, but nearly all had undergone more or less fatty degeneration.
and there was seen a large cell containing numerous small oil-glob-
the compound granular cell of pathologists.

he brain itself in meningitis is usually hyperæmic. On making an
on through it red points are seen upon the cut surface, which indi-
the seat of the congested vessels. The inflammation rarely extends to
walls of the ventricles, but the choroid plexus is injected. In excep-
l instances pus or fibrin is found in the lateral venticles. In the infant
nd a half weeks old whose case has already been alluded to about two
es of purulent fluid escaped on opening the left ventricle. A small
nt of liquid of a similar character was contained in the right ventricle.
distension of the lateral ventricles with serum is one of the common
ts of meningitis. This fluid is clear or straw-colored, or it is turbid.
quantity does not exceed two, three, or four ounces, and is often not
than one ounce or an ounce and a half. The distension of the two ven-
s is ordinarily uniform, as they are united by the foramen of Monro,
ow and then one ventricle is found more distended than the other. If
be considerable effusion, the brain is compressed and the convolutions
a flattened appearance, unless the cranial bones are still separated so as
ld to the pressure. If the sutures and fontanels be open, the cranial
is expanded, sometimes quite perceptibly to the eye. From the same
the anterior fontanel, if open, is elevated. The foramen of Monro is
ged according to the amount of effusion, and the portions of the brain
separate the ventricles are sometimes lacerated. In many cases the
ral substance surrounding the lateral ventricles is softened. The soft-
is found in all degrees, from the least appreciable deviation from the nor-
onsistence to a state of diffluence, so that the brain substance presents the
rance of cream. Hypotheses have been advanced to explain the cause
is change in consistence which are not entirely satisfactory. Whatever
xplanation, the fact is attested by all observers, though there are excep-
l cases. Thus Dr. West has records of the condition of the brain in 59
, in 37 of which there was considerable softening, and in the remaining
e consistence was normal.

ince a majority of the cases of meningitis in children are basilar, and
ons of all the cerebral nerves lie at the base of the brain, it is easy
derstand why the functions of these nerves are so seriously impaired in
lisease. Compression of these nerves or extension of inflammation to

their sheaths affords explanation of many of the symptoms, as the sighing respiration, abnormalities of the eye, etc.

Although the above remarks relating to the anatomical characters of meningitis are applicable to a large majority of the cases, I must confess that I have sometimes been disappointed at the autopsies of young infants who died with all the symptoms of meningitis in not finding more lesions. Moderate hyperæmia of the pia mater, its slight opacity or cloudiness at the base of the brain or elsewhere, with the presence of a few wandering white corpuscles, without any fibrinous exudation, with no increase of liquid external to the brain, but a considerable increase of it in the lateral ventricles, and hyperæmia of the choroid plexus, with nearly natural appearance and consistence of the brain, have in some instances been the only lesions when I had expected to find marked anatomical changes.

I am fully convinced from my observations that in some instances physicians who supposed that they were treating tubercular meningitis, and at the autopsies discovered within the cranium tubercles, without any inflammatory lesion, but with a larger increase of the cerebro-spinal liquid, have been treating cases in which, in addition to the meningeal tubercles which were latent, the bronchial glands were tubercular and cheesy, so that by their increased size they compressed the venæ innominatæ within the thorax, thus preventing the free flow of blood from the brain, and causing, as I have elsewhere stated, cerebral and meningeal congestion, with more or less transudation of serum, but with no meningitis. In tubercular meningitis the anatomical characters are like those in simple meningitis, with the addition of tubercles, which at first are minute and transparent, and are most easily detected when the inflammation has been slight. Seated in the pia mater, they cause some prominence of the arachnoid, and are best seen when so minute by an oblique light.

Causes.—The causes of non-tubercular meningitis are not fully ascertained. Active cerebral congestion frequently occurring, however produced, appears to be one of the common causes in young infants. In at least three instances I have known meningitis to occur in infants between the ages of four and eight months after severe and protracted bronchitis, which had been attended with the usual heat of head. The disappearance of eruption upon the scalp at or immediately before the commencement of the meningitis has also been observed. I have witnessed it at the commencement of non-tubercular meningitis, as well as of meningitis which, if not tubercular, occurred at least in a decidedly scrofulous state of system.

The direct effect of the solar rays upon the head and the prolonged action of a high atmospheric temperature, even without direct exposure of the head to the sun, are common causes during the summer months in New York City. I once attended a child with this disease who had been much exposed bareheaded to the direct rays of the sun in August and September, and at his death, which occurred toward the close of the hot weather, found hyperæmia, opacity, and fibrinous exudation in the pia mater at the summit of the brain, while the base of the brain seemed nearly or quite normal.

Dr. Soltmann[1] of Breslau reports three cases in which intense cerebral hyperæmia, and probably meningitis, occurred from solar heat. In all three children the attack was sudden, the febrile movement and heat of head intense, and the progress rapid. The first had convulsions, the second automatic movements, and the third, the oldest, aged four years, when able to speak complained of violent headache.

The statistics of New York City show that congestive and inflammatory maladies of the brain and its covering are more common during July and

[1] Jahrbuch f. Kinderkrank., for October, 1875.

August, which are the months of maximum atmospheric heat, than in other months of the year. For example, in July and August, 1875, 167 died of these maladies, or 1 in every 9.8 who died from local disease, while during the entire year only 710 died from the same, or 1 in every 15 who perished from local diseases.

July, 1876, in New York City was characterized by excessive and long-continued atmospheric heat, the temperature of the Central Park Observatory in the shade never falling below 61°, though never above 98°, and having a mean of 82.9°. There was also unusual dryness of the atmosphere, since during the entire month prior to July 30th there were only fourteen hours of rain with a rainfall of 0.77 of an inch, and the average atmospheric humidity was represented by 65, saturation being denoted by 100. During this month I treated in my private practice four fatal cases, all between the ages of two and seven years, which I diagnosticated meningitis, none of them presenting any symptoms of otitis or tuberculosis. It would seem that the atmospheric heat had much to do with the development of the disease in these cases. One died in two days, but in the others there was the usual duration. Gowers also mentions insolation among the occasional causes.

A not infrequent cause, especially among the strumous families of cities, is otitis media and caries of the petrous portion of the temporal bone, the inflammation extending to the meninges. Any suppurative inflammation occurring outside the dura mater, but in immediate proximity with it, may by extension cause meningitis; but the most common cause of this kind is purulent otitis. The external discharge of pus from the ear usually ceases when the meningitis begins. Gowers states that several cases are on record of meningitis occurring from traumatic inflammation of the eye, the inflammation probably passing along the sheath of the optic nerve. Gowers also states that the following acute diseases occasionally sustain a causal relation to meningitis: measles, scarlet fever, smallpox, typhoid fever, pneumonia, and acute rheumatism. But the meningitis occurring with or from pneumonia is probably cerebro-spinal fever, and meningitis occurring from the acute infectious diseases mentioned by Gowers is certainly rare, and perhaps its coexistence with them is in at least some instances a coincidence. Septic processes in any part of the system occasionally cause meningitis, probably from microbes, which, entering the circulation, are conveyed to the meninges. Since tubercular meningitis is due to the irritating effect of tubercles in or under the pia mater, it usually occurs where tubercles are most abundantly developed; that is, at the base of the brain and along the course of the vessels in the intergyral spaces. The inflammation is commonly excited when they are still small, even minute.

Premonitory Stage.—Meningitis is usually preceded by symptoms which, if rightly interpreted, are of the greatest value. In most cases of this malady which I have seen there was a prodromic period varying from a few days to several weeks. The symptoms of this period are obscure, and are liable to be mistaken for those of other and distinct affections.

The child in whom meningitis is approaching loses his accustomed vivacity and cheerfulness. He has a melancholy and subdued appearance, being quiet a few minutes, and then fretful, without apparent cause. He can sometimes be amused by his playthings or companions for a brief period, when he turns from them with evident displeasure. Unexpected and loud noises and bright lights are evidently painful. If old enough to describe his sensations, he complains of transient dizziness, and at other times of headache. His ill-humor, if his wishes are not immediately gratified or if they are denied, is often scarcely endurable on the part of friends who are ignorant of the cause. *There is great difference,* however, in different cases as regards this symptom.

Some are inclined to be taciturn and quiet, while others are almost constantly fretting. The appetite is capricious; at one time it is pretty good, at another it is poor or even entirely lost. The patient may take a few mouthfuls of food, or if an infant may nurse a moment, when his hunger appears satisfied and he will take nothing more. The bowels are regular or inclined to constipation. The pulse is natural or it has times of acceleration, especially in the latter part of the day and toward the close of the premonitory stage. The duration of this stage is very different in different cases. Upon an average it is perhaps about two weeks, but is often longer. In tubercular meningitis the symptoms, both during the inflammation and previously, are often complicated by those which arise from tubercles in other parts of the system.

Unless the prodromic period be of short duration the effect of imperfect nutrition is obvious before it closes. The flesh becomes soft and flabby or there is emaciation, though generally slight. The patient loses his strength, becoming less able to stand or to walk and more easily fatigued. Occasionally, especially in the non-tubercular form, premonitory symptoms are absent or are slight and of short duration.

SYMPTOMS.—Dr. Whytt, living in the last century, when the tendency was toward refinement rather than simplicity in classification, divided meningitis into three stages, according to the symptoms, especially the pulse. Many subsequent writers, following Whytt's example, have recognized three stages, based not upon the anatomical characters of the disease, but upon the succession of symptoms. Such division of meningitis is in great measure arbitrary, since in one case the same symptoms occur at an earlier period than in another.

When the premonitory stage has passed and inflammation is developed some of the symptoms which were previously present remain and are intensified, and other new and more characteristic symptoms appear. There are now fewer intervals of apparent improvement. The child is quiet, often lying with his eyes shut. If aroused he has a wild expression of the face and is irritated by attempts to engage his attention or amuse him. He rarely smiles or takes his playthings, or he notices them for a moment, when he turns away with disgust. During sleep there is often at first a placid expression of countenance, but when aroused he has the aspect of real sickness; the eyebrows are sometimes contracted, as if from headache; the features wear a melancholy look, and are turned away to avoid the gaze of the observer or to shun the light. If the anterior fontanel be open, it is observed to be prominent and pulsating forcibly. If consciousness be not lost and the patient be of sufficient age, he complains of headache or of pain in some part of the body. The tongue is moist and covered with a light fur; the appetite is lost or poor; there is seldom much thirst; more or less nausea and constipation are present. As the inflammation continues, and usually within three or four days from its commencement, symptoms arise which dispel all doubts, if there were any, as to the nature of the disease. The vital powers are now evidently beginning to yield. The surface generally is more pallid, and there is the curious phenomenon of the sudden appearance—and after some minutes disappearance—of spots or patches, or even streaks, of active congestion upon the face, forehead, or ears. These, having a bright-red color, contrast strongly with the general pallor. Ordinarily they are irregularly circular or oval, and from one inch to an inch and a half in diameter. A red spot or streak is also produced if the finger be pressed upon the surface or drawn forcibly across it. It continues a few minutes, and then gradually fades. Trousseau calls attention to this fact as a diagnostic sign. It is known as the *tâche cérébrale* of Trousseau, and it affords important aid in diagnosis.

Another curious phenomenon is the variation in temperature. The face and limbs at one time feel quite cool, and after some minutes, without any excitement or other appreciable cause, the temperature rises, so that the surface is warm to the touch.

Consciousness in severe cases may be lost at an early period. On the other hand, I have known it in a case of moderate severity to remain, though partially obscured, till within twenty-four or thirty-six hours of death. The patient will usually open his mouth for drinks which are placed to his lips when there is no other evidence of intelligence and when sight and hearing are evidently lost.

The loss of the senses constitutes an interesting but melancholy feature of the disease. Among the first unequivocal signs, and frequently the very first, are such as pertain to the eye. This organ should be watched from day to day when the diagnosis is uncertain. Deviation from its normal state affords evidence of meningitis. The pupils are seen to dilate or contract sluggishly by variations in the intensity of the light, or they are not of the same size with those of another individual to whom the same amount of light is admitted. Sometimes the first perceptible deviation from the normal state is an inequality in the size of the pupils, while in others oscillation of the iris is observed. Later, when convulsions have occurred, the parallelism of the eyes is lost. After effusion has taken place the pupils are commonly dilated. As death approaches the eyes become bleared and a puriform secretion collects in the inner angle of the eye and between the eyelids. This secretion is not abundant, but it is sometimes sufficient to unite the lids. The sense of hearing is probably lost as soon, or nearly as soon, as that of sight, but the sense of touch continues longer. The tongue is covered with a moist fur, unless near the close of life, when it is sometimes dry. The appetite is gradually lost, but often drinks are taken with apparent relish, even when there is no other evidence of consciousness. There are two symptoms pertaining to the digestive system which are rarely absent, and which possess great diagnostic value; one is vomiting, the other constipation. In some patients irritability of stomach begins at so early a period that it is really prodromic; it is rarely absent. Barrier collected the records of 80 patients with meningitis, and in 75 of these this symptom was present. It is due to the intimate relation existing between the stomach and brain through the ganglionic system of nerves. The vomiting occurs without effort, and usually at intervals for several days. It is a sudden ejection of the contents of the stomach, apparently without preceding or subsequent nausea. It contrasts, therefore, with the vomiting due to an emetic, which is attended by distressing symptoms. With some it occurs frequently, with others not more than two or three times daily. Commencing in the first stages of meningitis or even prior to it, it occurs less often as the drowsiness becomes more profound, and finally ceases. Constipation is also present, usually from the commencement of the meningitis. It is one of the most constant and persistent symptoms, continuing through the entire sickness, unless relieved by medicine or unless there be a coexisting diarrhœal affection. Often, when diarrhœa precedes the meningitis, it ceases the moment the latter commences. The constipation in this disease is easily overcome by purgatives. Several writers speak of retraction of the abdomen as a sign of meningitis. A hollow or sunken appearance of the abdomen, according to Gölis, aids in distinguishing meningitis from fever. The anterior abdominal wall approaches the spine, so that the pulsations of the abdominal aorta are distinctly felt. Rilliet and Barthez, who have rarely observed this retraction except in cerebral diseases, attribute it to the state of the intestines rather than to the action of the abdominal muscles.

being called chronic, even when there is a large amount of exudation upon the pia mater. In the few cases which end favorably the symptoms abate gradually. I shall describe more fully the termination in speaking of Prognosis.

DIAGNOSIS.—It is of the utmost importance to diagnosticate meningitis in its first stages, since treatment to be successful must be commenced early. Certain writers describe at length the means of diagnosticating the simple from the tubercular form of the inflammation. Differential diagnosis is often difficult, and sometimes impossible; but it matters little, practically, whether the form of the disease be ascertained. On the other hand, it is very important, in order that the treatment be appropriate, to diagnosticate the premonitory or initial stage of meningitis from certain other affections not located within the cranium. Sometimes remittent or continued fever or constitutional disturbances arising from irritation in the digestive system simulate closely incipient meningeal disease, so that the greatest care and discrimination are required in order to make a correct diagnosis. Within a comparatively recent period I have known in three different instances experienced physicians of this city to mistake commencing meningitis for fevers, not aware of the serious error they had made till the inflammation had reached a stage from which recovery was impossible. In order to avoid error in the diagnosis in the premonitory or initial stage of meningitis, the physician should take time to observe the physiognomy and note every symptom. More than one protracted visit is often required to remove doubt as to the exact pathological state.

Meningitis is usually preceded, and in its commencement accompanied, by greater restlessness, fretfulness, intolerance of light, and a greater variation of symptoms, than most other maladies. One familiar with the physiognomy of infancy and childhood will discover in the features indication of greater suffering, of more serious sickness, than is commonly present in other maladies which simulate this.

Sometimes the sudden disappearance of a chronic eruption upon the scalp will aid in the diagnosis. This is a sign of importance, taken in connection with the symptoms. Headache and vomiting, symptoms of early occurrence, should especially arrest attention, or in absence of headache pain of a neuralgic character in some other part. But we may repeat that familiarity with the symptoms of meningitis will not protect from error if the visits of the physician are hasty and his examinations imperfect. When the eyes become affected, the respiration and circulation irregular, and especially when convulsive attacks begin, diagnosis is easy. In fact, an incorrect diagnosis would then be unpardonable; but, unfortunately, if proper treatment have not been commenced till this period it will be of little service.

PROGNOSIS.—Meningitis is one of the most fatal maladies of early life. Whether the form be tubercular or not, if the initial stage have passed without proper treatment death may be considered inevitable. Tubercular meningitis, however early recognized, is rarely amenable to treatment. M. Guersant[1] believes that recovery from the first stage of this form of meningitis is possible. "In the second stage," says he, "I have not seen one child recover out of a hundred, and even those who seemed to have recovered have either sunk afterward under a return of the same disease in its acute form or have died of phthisis. As to patients in whom the disease has reached its third, I have never seen them improve even for a moment." The very few reported cases which resulted favorably may have been, as M. Guersant has intimated in the context, cases of the non-tubercular form. Rilliet and Barthez believe that in a few instances tubercular menngitis has been cured in its first stage, but they state also that it is apt to return

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[1] Dict. méd., t. xix. p. 483.

The prognosis in non-tubercular meningitis is not so unfavorable, provided that treatment be commenced at a sufficiently early period. It is now generally admitted that it may not infrequently be averted when threatening, and even arrested in its incipiency. In many such cases we cannot, from the nature of the disease, be certain that the diagnosis is correct. But when we see children relieved who present precisely those premonitory and even initial symptoms which occur in meningitis, we must believe that at least some of them would have had the genuine disease if not relieved by the measures employed. That in its commencement recovery is possible from non-tubercular meningitis is also obvious from the fact that a few recover even in the second stage, when there can be no error of diagnosis.

Although a considerable proportion of patients with epidemic cerebrospinal meningitis recover, even when the symptoms have been most grave, I have known only two recoveries from sporadic meningitis when it had reached that stage in which the functions of the brain and cranial nerves were impaired. One of these recovered with permanent loss of sight, the other with loss of hearing. Both seem to have ordinary intelligence. Another case has been communicated to me in which the patient, a little child, recovered completely, but for several months after the attack seemed nearly idiotic.

Sometimes, even in the second stage of meningitis, treatment properly employed is attended by amelioration of symptoms. Though such improvement may serve to encourage physician and friends, it should not be the basis for a favorable prognosis unless it continue three or four days.

Apparent improvement during a few hours or a considerable part of a day is not unusual in those who finally die. Thus, in an infant whose bowels were previously confined I have known the pulse and respiration to become more regular and the symptoms generally improve, though only for a brief period, by the action of a purgative. Dr. Watson says of the advanced stage of this disease, it is "often attended with remissions, sometimes sudden and sometimes gradual—deceitful appearances of convalescence. The child regains the use of its senses, recognizes those about it again, appears to its anxious parents to be recovering, but in a day or two it relapses into a state of deeper coma than before. And these fallacious symptoms of improvement may occur more than once."

Most fatal cases of meningitis terminate between the third or fourth and the twentieth day, the duration varying according to the extent and intensity of the inflammation and the vigor and age of the patient. But there are cases in which it may continue much longer. It is surprising sometimes how long the patient lives when the symptoms are such that death seems impending. Sensation and consciousness may be extinguished, convulsions occur at intervals, and the surface have acquired almost a cadaveric aspect, and yet the patient lives on. Rilliet and Barthez say: "Often have we inscribed upon our notes *death imminent*, and been astonished the next day to find still alive children to whom we had scarcely allowed two hours of life." The symptom which I have found to be the most reliable prognostic of the near approach of death has been a pulse gradually becoming more frequent and feeble, though other symptoms remain as before. This change in the pulse is usually very apparent during the last twenty-four hours of life.

TREATMENT.—Such remedial measures should be prescribed during the premonitory stage as are calculated to relieve the fretfulness or irritability of temper and quiet the action of the brain, and at the same time produce a derivative effect from this organ. To this end the patient should be kept from all causes of excitement, and the bowels should be opened daily—if not naturally, by the use of proper medicines. A mustard foot-bath at night and occasionally through the day is useful, as it produces both a derivative and soothing effect. It will commonly produce a few hours' undisturbed rest, while other measures except medicines fail. If dentition be taking place and the gums are swollen, it has been the practice to employ the gum lancet, and still is with some physicians, but I for one have discarded its use for this purpose. Restlessness from dentition or restlessness premonitory of meningitis requires large doses of bromide of potassium, which will relieve the symptoms more effectually than the lancet. Three grains should be given to a child of six months, and four grains to one of ten or twelve months, and repeated if necessary in two to four hours. If symptoms indicate the near approach of meningitis or its incipiency, the head should be kept constantly cool by a cloth wrung out of ice-water—or, better, an India-rubber bag containing ice. Some physicians have recommended vesication back of the neck or ears, but it is a measure of doubtful benefit, and if employed at all should be restricted to the application of cantharidal collodion behind the ears.

Many children who are threatened with meningitis are scrofulous. They have already shown symptoms of tubercular disease. They are perhaps, to a certain extent, emaciated, and may have been affected with a cough. If the premonitory symptoms in children indicate the approach of the tubercular form of meningitis, a more sustaining course of treatment is required than in those who are robust. To such children cod-liver oil may be profitably given three times daily, together with the syrup of the iodide of iron and perhaps the bromide. They should also be taken into the open air with proper precautions, and every hygienic measure should be employed which will be likely to invigorate the system without exciting the brain.

Loss of blood is not, in general, required during the prodromic period nor in the disease. Those of a strumous cachexia, or those, whether strumous or not, who are under the age of two years, do not, unless in very rare instances, require depletion by leeches, much less by venesection. There is one class of patients in whom the early loss of blood may perhaps be of service—namely, those who in a state of robust health are suddenly seized with inflammation, especially if the cause be insolation. Leeches may then be applied to the head of the patient if he be seen at an early period, but the majority of physicians probably wisely recommend the ice-bag in preference to leeching.

Often, notwithstanding the measures employed, the patient grows worse; the symptoms become more continuous, others more alarming arise, and meningitis declares itself. Whatever the cause of the inflammation, and whatever modifications of treatment were required in the premonitory stage on account of special indications, the purpose now is to subdue the inflammation by every resource in our art which does not injure or too much prostrate the system. In former days calomel was largely employed as the main remedy in this disease, but when administered daily it has a very depressing effect, and it is to be borne in mind that in meningitis the vital powers progressively fail on account of the loss of appetite, vomiting, etc. In tubercular meningitis depressing treatment is of course strongly contraindicated. Cases have occurred in which calomel was given at short intervals for several successive days, so as to produce a laxative effect, but, though the meningitis seemed to be controlled, death resulted from exhaustion or from some intercurrent affection due to exhaustion. Thus in one case formerly related to his class by a distinguished New York professor [illegible] gangrene of the mouth supervened from the mercurial treatment after the meningeal inflammation had apparently subsided. Although calomel during these last years has been properly discarded as the main remedy and its daily use rejected, nevertheless it is very useful as an occasional laxative in the more robust cases if not given too near the iodide of potassium, and it is especially indicated as a derivative from the head in children of four or five years who, previously hearty and strong, have become suddenly affected with meningitis, as from exposure to the sun's rays or from an injury. But I repeat the belief that in ordinary cases calomel should never be employed, except as an occasional laxative.

The two remedies upon which we must chiefly rely are the iodide of potassium and the bromide of potassium or sodium. While the bromide quiets the restlessness, prevents convulsions, and diminishes, there is reason to think, to a certain extent, the hyperæmia, the iodide is useful as a sorbefacient, and it probably has some control over the inflammation. The iodide or bromide can be given together or separately.

The iodide should, like the bromide, be given early. If by a careful examination the absence of any other local disease or constitutional disease which might give rise to the symptoms be ascertained, and the symptoms indicate the meningeal disease, the iodide should be immediately prescribed. Obscurity often hangs over meningitis at this early stage, but it is better to give the iodide, even if the diagnosis be wrong and no inflammation have commenced, than to err on the other side, and withhold it in the initial period of the true disease; for it is not an injurious remedy like calomel, and to exert any marked effect it should be given in the commencement of the inflammation. An infant of the age of six to twelve months should take two grains every two hours, and older children a proportionate dose. At the same time the bromide should be given in doses twice as large as that of the iodide if the indications for its use are present—to wit, headache, restlessness, and symptoms which threaten eclampsia. The bromide is a harmless remedy given frequently for a limited time. With the regular and continued use of the iodide and occasional doses of bromide the quantity of urine is in most cases largely increased. If the patient's condition do not soon begin to improve with such treatment, there is no remedy.

If convulsions occur, the bromide should be given every ten or fifteen minutes till they cease. If they be not controlled by the bromide, an injection, *per rectum*, of three to five grains of hydrate of chloral in a teaspoonful of water should be used in addition. Compresses wrung out of ice-water frequently applied to the head, or a bladder containing pounded ice and separated by one thickness of muslin from the head, materially aid in reducing the meningeal hyperæmia. Ergot, recommended by Brown-Séquard for its supposed effect in diminishing the hyperæmia in the inflammatory diseases of the nervous centres, may also be employed as an adjuvant in the treatment of this disease.

In the first stage of simple meningitis the diet should be mild and in moderate quantity, but in the tubercular form it should from the first be of the most nourishing kind, consisting of beef tea, milk porridge, etc. At a more advanced stage in both forms of the malady the most nutritious diet should be allowed, but alcoholic stimulants should not be given unless near the close of life, when the vital powers are failing. The apartment should be cool and quiet.

CHAPTER IX.

SPURIOUS HYDROCEPHALUS.

THE disease known as spurious hydrocephalus might with more propriety be called spurious meningitis. It received its appellation at the time when meningitis of early life was believed to be essentially a hydrocephalus, and was so called. Attention was first directed to it by London physicians of the last generation, particularly by Drs. Gooch, Abercrombie, and Marshall Hall, and little can be added to their description of its symptoms.

ANATOMICAL CHARACTERS.—This disease, though resembling meningitis in certain of its phenomena, is not in its nature inflammatory, nor is it primary. It is the result of some malady often chronic, but occasionally acute, which has produced exhaustion, especially of the nervous system. When it commences there is usually more or less emaciation and the symptoms of the primary disease are present. To this disease the lesions pertain which are found in other organs besides the brain.

The state of the brain in spurious hydrocephalus is not the same in all cases. In some there is no appreciable anatomical alteration in this organ. There is no apparent difference, either in the meninges or the brain itself, from the condition which we often observe in those who have died of diseases which do not affect the cerebro-spinal system. In such cases the pathological state is simply deficient innervation, or if there be a structural change in the minute anatomy of the brain, pathologists have not yet discovered it.

The following case, which occurred in the Child's Hospital of this city, is an example of this form of spurious hydrocephalus:

CASE.—A female infant, six months old, died on the 24th day of April, 1862, with the following history: It was wet-nursed, fleshy, and apparently well till six days before death, when symptoms of gastro-intestinal inflammation were suddenly developed. The vomiting especially was severe, continuing forty-eight hours. When it ceased drowsiness supervened and continued till the close of life. The face during the four days of stupor was pallid and cool; eyes partly open, pupils sluggish, but of equal size; bowels rather torpid; anterior fontanel depressed. When aroused the infant noticed objects for a moment, and immediately relapsed into sleep; pulse accelerated and not intermittent, the day before death numbering 150; respiration accelerated, without sighing, numbering on the same day 30. There were no convulsions, and death occurred quietly. The brain weighed twenty and a half ounces, and its appearance was perfectly healthy, both as regards consistence and vascularity. The amount of cerebro-spinal fluid in the ventricles and at the base of the brain was not notably increased. The stomach, small and large intestines, were vascular in streaks and patches.

In this case the cerebral symptoms were obviously due to exhaustion occurring at an early period in consequence of the severity of the gastro-intestinal malady.

In a majority of cases, however, of spurious hydrocephalus, according to my observation, there is an anatomical alteration in the state of the brain and meninges. This consists in passive congestion of the veins, often with transudation of serum. At the same time, the cranial sinuses are congested, and are found at the post-mortem examination to contain larger and more numerous clots than are present in those who die of diseases which do not affect the encephalon. Cases might be cited as examples. The cause of this congestion and effusion is in great measure feebleness of the circulation due to the general exhaustion of the patient. But there is another cause. In protracted diseases, especially those of a diarrhœal character, there is more or less wasting of the brain as well as of other parts. This naturally, by way of compensation, gives rise to congestion of the cerebral and meningeal veins and capillaries and to transudation of serum.

The transudation commonly occurs in this malady over the superior surface of the brain and in the subarachnoidal space, perhaps also more or less in the lateral ventricles. So common is it in the last stage of infantile entero-colitis, the summer epidemic of cities, that this stage, which is really spurious hydrocephalus, has been called the stage of effusion. I shall relate in another place examples which show the anatomical characters of this intestinal disease.

SYMPTOMS.—Spurious hydrocephalus most frequently results from protracted diarrhœal complaints. It may, however, result from any disease which is attended by great prostration. As it ordinarily occurs, the patient has for days or weeks been gradually losing flesh and strength. Finally, drowsiness supervenes, or before the drowsiness there is sometimes a period of irritability.

Marshall Hall describes two stages of spurious hydrocephalus. In the first, he says, "the infant becomes irritable, restless, and feverish; the face flushed, the surface hot, and the pulse frequent; there is an undue sensitiveness of the nerves of feeling, and the little patient starts on being touched or from any sudden noise; there are sighing and moaning during sleep, and screaming; the bowels are flatulent and loose and the evacuations are mucous and disordered." The second stage he describes as that of torpor. The first stage often, however, does not present those prominent symptoms which have been described by Dr. Hall, and this stage may even be absent or not appreciable, especially in young infants.

Whether or not commencing with the stage of irritability, the disease, if not checked, gradually increases. The child soon becomes drowsy. He may be aroused for a moment, but unless constantly disturbed immediately relapses into sleep. He is sometimes fretful when aroused, but in other instances is quite indifferent, observing without apparent interest objects employed for the purpose of amusing him. Often there are indications of cerebral pain or distress, as contraction of the eyebrows, etc., but many of those affected are too young to make known their sensations. Convulsions sometimes occur toward the close of life, but they are not so common in this disease as in meningitis. When they do occur they are generally partial and often slight. The pulse is accelerated in most patients prior to and in the commencement of spurious hydrocephalus. As the disease advances it becomes irregular and intermittent, and toward the close of life it is progressively more frequent and feeble. The respiration at first is not much disturbed, but at length it becomes irregular, like the pulse. It is feeble and accompanied by sighs. Occasionally, there is slight cough. The eyelids are partly open, the pupils no longer respond to light, and in advanced cases they have a bleared appearance. The diarrhœa, which in most instances precedes and causes this malady, continues till the stage of stupor arrives, when the evacuations become less frequent or cease altogether. In infants the stools are frequently green, in older children brown and sometimes slimy. The febrile heat of surface which preceded the disease, and which was present in its commencement, disappears; the face and hands become cool, the features pallid, and the anterior fontanel, if open, is depressed. Death finally occurs in a state of coma, or if the disease be recognized and proper remedial measures employed the result may be favorable, even when the symptoms are such that if meningeal inflammation were the malady we would consider the case necessarily fatal.

The following case is an example of spurious meningitis as we often meet it in practice:

CASE.—On the 13th day of March, 1859, I was asked to see a male child twenty-two months old, whose history was as follows:

"He was well till about three weeks ago, since which time he has had diarrhœa, with febrile symptoms; pulse 162, respiration 52; has a slight cough, with a few mucous râles; resonance on percussion of chest good; is somewhat emaciated, and appears languid; tongue moist and slightly furred. Has all the incisor and three anterior molar teeth, and the gum is swollen over the remaining anterior molar and two canine teeth.

"From the 14th to the 18th there was no material alteration in his symptoms, with the exception that the diarrhœa was partially restrained by Dover's powder in one-and-a-half-grain doses. On these five days the stools numbered daily from one to six. The pulse was uniformly frequent, varying from 124 to 156, and the respiration on two days, when its frequency was ascertained, numbered 56 and 46.

"March 19th, pulse 124; has become drowsy since yesterday, and when aroused is fretful. Omit Dover's powder. Treatment, cold applications to the head, mustard pediluvia.

"Evening pulse, 136; eyes constantly closed and head reclining; surface generally warm; tongue dry and furred; he vomited at first, but has not in three or four days. Apply cantharidal collodion behind each ear and continue the local treatment.

"20th, pulse 130; is constantly sleeping, and when aroused is very fretful and soon relapses into sleep; no unnatural heat of head, and no dejection since yesterday. Treatment, a dose of castor oil, nourishing diet.

"21st, drowsiness as before; cheeks sometimes flushed, sometimes pallid; pupils sensitive to light; margins of eyelids covered with secretion. The bowels have been opened by the oil."

On the 22d and 23d there was no material change in the symptoms. He was constantly sleeping, except for a moment when shaken. More active stimulation was now employed. Brandy was prescribed, to be given every two hours; beef tea and milk porridge frequently.

On the following day, the 24th, he was more fretful and less drowsy. Brandy and beef tea were continued.

On the 25th, with the same treatment, there was still further improvement; drowsiness nearly gone and less fretfulness than yesterday; rolls the head occasionally and does not appear to see distinctly; has a slight cough; stools nearly regular; pulse 100; respiration natural; surface warm, and no unnatural heat of head. The same treatment was continued, and he rapidly and fully recovered.

This case is interesting on account of the long duration of marked drowsiness, which continued five days, and yet the patient recovered entirely in the space of two or three days under the use of brandy and beef tea.

In May, 1860, I treated a similar case. A child twenty months old had diarrhœa for two weeks, the stools being of a dark-brown color, thin and offensive. He was at first very irritable. The pulse was constantly above 130, and the respiration was correspondingly increased. The stage of drowsiness finally supervened, and for two days he was constantly asleep unless aroused by being shaken. During the somnolent stage the pulse numbered 140, respiration 36. The face and extremities were cool, and he finally had a slight convulsion. By stimulants and nutritious diet he began immediately to improve, and was soon out of danger.

In the following case the result was unfavorable. This case is interesting on account of the anatomical characters of the disease as disclosed by the post-mortem examination. It is an example of that large class of cases

purious hydrocephalus is associated with congestion of the cere-
and serous effusion. It is exceptional, however, as regards the
ion of drowsiness. Ordinarily, protracted diarrhœal maladies
in passive congestion and effusion terminate fatally in three or
after the drowsy period arrives:

"Dec. 13, 1861, called to-day to a German infant eighteen months old.
liarrhœa four weeks without regular and proper medical attendance;
the first brown and thin; during the last eight or nine days he has
y; when aroused opens his eyes and is very fretful, but immediately
yelids gradually droop, and unless disturbed he remains asleep with
rtially open; forehead warm, face cool and pallid, and limbs also
; pulse 164, respiration 32; has had a slight cough about one week,
lulness on percussion over the left infrascapular region; depression of
ary region on inspiration. Treatment: Ammon. carbonat., gr. 1
hours; nourishing diet.
0th, has continued drowsy since the last record; pupils moderately
hick secretion between eyelids; right pupil considerably larger than
sion apparently lost during the last three days; pulse over 140;
44 per minute, accompanied by sighing since the 18th; moans much
e; rolls the head frequently; during the last six days the surface
ears has been constantly sore by vesication; takes the most nutritious
randy. The stools remain thin and brown and number three or

this date the diarrhœa continued, except as it was restrained by veg-
gents. The pulse continued frequent and a slight cough remained.
n the 21st and 22d partial abatement of the drowsiness, but on the
reater than ever. The body was somewhat reduced at the commence-
cerebral symptoms, but it was now markedly emaciated. The pros-
eased daily, and the hands were observed to tremble. The face and
me more cool, while the head was warm. On the 24th partial con-
curred, followed by coma and death.
rebral veins and sinuses were generally congested, except in the
tion of the brain, where the appearance was normal. Between the
its membranous covering, chiefly at the vertex and the base, was an
clear serum. The whole amount of this fluid was estimated at two
slicing the brain numerous 'puncta vasculosa' were seen, both in
d white portions. With the exception of the congestion the sub-
e brain presented its normal appearance. No inflammatory lesions
t. We were not permitted to examine the condition of the intes-

SIS.—The only disease with which spurious hydrocephalus is
e confounded is meningitis. The points of differential diagnosis
story of the case, especially the antecedent diarrhœa or other
ailment, evidence of prostration when the cerebral malady com-
pression of the anterior fontanel if it be open, and the cool face
ities.
SIS.—If the pathological state of the brain be simple exhaustion,
can often be arrested by judicious treatment. If an incorrect
e made and the treatment employed be that appropriate for
which it so closely simulates, death is almost inevitable. If
n of serum have occurred, unless slight, the result is usually
whatever may be the treatment. This disease in childhood is
managed than in infancy, but is less frequent. The prognosis is
e cool months than during the heat of summer. It is more favor-
child be over than if under the age of one year. The occurrence
ular and intermittent pulse, of respiration accompanied by sighs,
ty in the pupils or their sluggish movements, with increasing
icates an unfavorable issue. The cure of the primary disease,

with the pulse and respiration still natural or accelerated, without ch
rhythm, pupils sensitive to light, drowsiness from which the patient i
aroused to a state of entire consciousness, render recovery probab
proper medication and alimentation.

TREATMENT.—The indications of treatment are twofold: first, to
the primary pathological state which is the cause of the spurious
cephalus; and, secondly, to cure the latter. The first is importan
the successful treatment of a disease requires the removal of th
The measures employed for this purpose are pointed out in our des
of the diarrhœal and other maladies which produce spurious hydroc

We may here say that, as spurious hydrocephalus is due in a ve
proportion of cases to the exhausting effect of long-continued di
astringents, especially subnitrate of bismuth, and alkalies are requi
majority of cases in the stage of irritability, and sometimes also o

Active sustaining measures are indicated. Exhausted nervous
as well as passive cerebral congestion, requires these. The diet sh
highly nutritious, comprising such substances as milk and beef jui
should be given frequently. Brandy is required at short interval
Gooch was in the habit of giving the aromatic spirits of ammonia, p
diluted, as a quick and active stimulant. Six or eight drops may b
in sweetened water to a child one year old, and repeated every hour i
of urgency. If by proper treatment of the cause and by the use of
lants and nutritious food the patients do not within a few hours bec
stupid and more conscious, there is that degree of nervous exhaustio
serous transudation from the engorged cerebral veins which will
death probable. In some cases it is proper to produce moderate ve
behind the ears.

CHAPTER X.

ECLAMPSIA.

THE term "eclampsia" is used in a more restricted sense by son
than by others. It is employed in the following pages to design
convulsive seizures, clonic in their character, sometimes general,
partial, which affect the external muscles, and are due to some excit
It consists in rapid, forcible, and involuntary muscular contraction a
with relaxation. It is distinguished from chorea in the fact that
is a more permanent state, and is characterized by muscular movem
are partially under the control of the will and are not so violent.
toms of eclampsia closely resemble those of epilepsy, but these di
distinguished from each other by characters which will be menti
after.

Eclampsia occurs in a great variety of diseases, some of which a
in the cerebro-spinal system, some in other parts of the body, and
constitutional. It may also be produced by temporary derangeme
tem not sufficiently severe to be considered diseases, and by power
impressions, those of an emotional nature affecting the delicate an
nervous system of the child. Pathologists recognize three differen
eclampsia. The term essential or idiopathic is used when the c
have no appreciable anatomical character; that is, when there is

ical state in the brain or elsewhere which gives rise to the
example, if a child die in convulsions from fright, and all the
ling the brain, are found in their normal state, the eclampsia is
hic or essential. If the cause be disease of the brain or spinal
med symptomatic. If eclampsia arise from local disease else-
the cerebro-spinal axis, as from pneumonia, the term sympa-
oyed. This is in the main a good division, but eclampsia may
e time sympathetic and symptomatic, as when it occurs in con-
congestion of brain which is induced by severe and frequent
whooping cough.

-Eclampsia occurs at any period of infancy and childhood, but
ore rare after the period of six or seven years than previously.
n are more liable to it than others. It is produced in one
which in another has no appreciable effect. There are some,
e of an impressible nervous system, who are seized with con-
ever there is any slight derangement in the digestive or other
mpsia is frequent in certain families. Thus, Bouchut mentions
n persons all of whom had convulsions in their infancy. One
ried and had ten children, who, with one exception, had con-

ng causes of eclampsia are too numerous to be mentioned in
symptom in nearly all cerebral diseases. It is produced in the
hanges in the milk with which it is nourished. These changes
e to violent emotions of the mother, as anger, fright, and grief,
acescent or indigestible food, or to derangement, temporary or
her health. Thus, in a case related to me the catamenia so
ilk that the infant was seized with eclampsia at each monthly
hildhood the most common cause of clonic convulsions is the
ome irritant in the primæ viæ. All kinds of fruit, even the
produce eclampsia, especially when eaten unripe or taken in
y. I have known an infant to be seized with convulsions from
erries, which parents usually regard as harmless, and one of
ent and protracted cases of eclampsia which I have witnessed
child over the age of six years from swallowing, in considerable
parenchymatous portion of an orange. Constipation, worms,
ussusception, and painful dentition are also causes which are
digestive apparatus. Inflammation in some part of the respi-
us is a not infrequent cause. Thus, eclampsia occurs occasion-
coryza, in consequence, according to some, of the proximity of
surface to the brain and the consequent afflux of blood to this
a common complication also of pertussis and pneumonia. It
at the commencement of two of the eruptive fevers—namely,
scarlet fever, and in the course of the latter disease.

otions of the child may also cause eclampsia. Bouchut relates
girl five years old who was corrected before her companions,
fected by anger that convulsions ensued. Residence in close
d apartments or in streets where the air is loaded with offensive
stifling, is a predisposing cause, so that there is a larger propor-
from convulsions in the cities than in the country.

children burns, even when not very severe, are liable to termi-
in eclampsia, succeeded by coma and death. Urinary calculi,
vesical, may produce the same result.

the more common causes of eclampsia. It is seen that they
inds, predisposing and exciting. An excitable or impressible
ervous system constitutes the chief predisposition to the dis-

ease. Plethora, or its opposite state anæmia, increases the liability to an attack.

PREMONITORY STAGE.—In the majority of cases there are prodromic symptoms which the experienced and careful physician can detect so as to forewarn friends. The child is perhaps more or less drowsy, and, when disturbed, fretful. The eyes often have a wild or unnatural appearance; occasionally they are fixed for a moment on an object, and yet apparently without noticing it. The sleep is disturbed; in some there is unusual heat of head, and, if old enough, complaint of headache. At times, especially if the primary disease be febrile or inflammatory, there is incoherence of thought or expression, or even actual delirium. In some children when eclampsia is threatening the thumbs are seen to be carried across the palms. I have observed this especially during the convulsive cough of pertussis. A very important prognostic symptom is sudden starting or twitching of the limbs. This shows that the nervous system is profoundly impressed, and but slight additional excitation is required to develop eclampsia. This sudden starting not infrequently precedes the attack several hours and gives sufficient warning.

The prodromic symptoms are often disregarded by friends who do not understand their significance. Even physicians, in the haste of their visits, in many instances do not notice them. The symptoms which precede symptomatic and sympathetic eclampsia are, moreover, blended with those of the primary affection, and hence another reason why they are frequently overlooked. When the convulsions are about to commence the child generally lies quiet; the eyes are open and fixed. If spoken to or shaken he takes no notice and does not speak. The direction of the eyes is then changed; often they are turned up; occasionally there is strabismus. The face may be pale or flushed, and sometimes, especially in cerebral diseases, the features present patches or streaks of a flushed appearance, while around them the natural color is preserved. Immediately before the spasmodic movements the child sometimes utters a piercing scream, which is probably involuntary, though it seems like a supplication for help. The duration of the prodromic stage is very different in different cases. It may last from a few minutes to several hours, or even more than a day.

SYMPTOMS.—Eclampsia is general or partial. If *general*, the muscles of the face, eyes, eyelids, and of all the limbs are in a state of rapid involuntary contraction, alternating with relaxation. The features lose their natural expression and are distorted; the mouth is drawn out of shape, often to one side, by the violent muscular action; the teeth are pressed together by the contraction of the masseters, and may be violently struck together, so as to lacerate the tongue if it protrude, or are ground upon each other. Unless the attack be of short duration, frothy saliva, perhaps tinged with blood from the injured tongue, collects between the lips. The eyelids are usually open, and in severe cases the eyes are turned so that the pupils are lost under the upper eyelids, or the muscles of the eyes are involved in the spasmodic movement so that the eyeballs are forcibly drawn from side to side. Occasionally strabismus occurs. While the features are thus distorted the head is strongly retracted or is turned to one side; the forearms are alternately pronated and supinated; the thumbs and fingers are convulsively flexed, so that the thumbs lie across the palms and are covered by the fingers; the great toe is adducted, the other toes flexed; and the toes, as well as legs, participate more or less in the spasmodic movements.

In general convulsions, consciousness is usually lost. The head is hot previously to and during the attack—at least in the first part of it—and the face flushed. In exceptional cases, especially in sympathetic eclampsia, the

cool and the face pallid. The pulse is somewhat accelerated, as well
espiration, and the latter is rendered irregular if the respiratory mus-
ecially those of the larynx, are involved, as they generally are. The
ers are relaxed during the convulsive attack, so that in many cases the
d stools are passed involuntarily.

TIAL eclampsia is more common than the general form; it occurs in
scles of the face, including those of the eye, of the face and of one
upper extremities, or of the face and the extremities on one side.
smodic movements may be even limited to the muscles of the eye,
often occur only in these muscles and those of the face. Rarely,
does eclampsia affect the legs without affecting also the muscles of
and face. In partial convulsive attacks sensation and consciousness
ome patients not entirely lost, but in others they are not manifested
nt.

duration of an attack of eclampsia varies in different cases from a
utes to several hours, with an average of not more than from five to
minutes. The movements do not often continue longer than three or
urs in the severest cases. They are sometimes said to last a much
time, even for days, but in these cases there are intermissions. Violent
are usually short.

en the convulsion ends favorably the spasmodic movements become
less strong, and finally cease. The child then takes a deep inspira-
er which it lies quiet, and the respiration remains regular or mod-
accelerated. Some fully recover in a few minutes if the eclampsia
en light and the cause transient, and seem to experience no incon-
e except soreness of the muscles and fatigue. Others soon recover
sness, and their temperature, respiration, and circulation become
, but they remain dull for a time, their minds are bewildered, and
e perhaps unable to speak. In a few hours these untoward symptoms
ay. In essential, and in a large proportion of cases of sympathetic,
ia, if properly treated and if the cause be recognized and removed,
no recurrence of the convulsion; with others it is different. In many
specially of symptomatic eclampsia, and of sympathetic in which the
s grave and persistent, the convulsions return after a variable period
w minutes or a few hours. Six or eight or more convulsions may
ithin twenty-four hours. Rarely they occur several times daily for
consecutive days, but severe convulsions, repeated at short intervals
ty-four or forty-eight hours, usually end in fatal congestion of the
r serous effusion. I once attended an infant about six months old
d from four to twelve convulsions daily for eleven days, caused prob-
a vesical calculus, as there was dysuria and at times bloody urine.
ays after the convulsions were controlled, while we were deferring
tion of the bladder, death occurred suddenly, and an autopsy was not
ed. This case will be detailed elsewhere. Bouchut has witnessed a
whooping cough in which there were daily convulsions for eighteen days.
evere eclampsia the respiration is so embarrassed and circulation so
that congestion of various organs results. This passive congestion
respiratory organs is indicated by moist râles in the larynx and bron-
bes; occurring in the brain, it is indicated by profound stupor. It
eady been stated that death may occur from the cerebral congestion,
continuing, is apt to end in effusion of serum or extravasation of blood.
e cases the convulsive movements cease, but there is no return of con-
ess. The child lies quiet, as if in sleep, with pupils not readily acted
ight, and often somewhat dilated; gradually the limbs grow cool and
e *feeble, and fatal coma* supervenes.

Death does not ordinarily occur from one attack. There are seve intervals, during which the stupor is gradually becoming more and mor found, till finally total loss of consciousness and sensation results, termi in death. Apnœa may occur in the first attack, ending life abrupt unexpectedly, but in other instances it does not result till after several ures, when at length one more violent than the others interrupts the re tory function and causes death.

Occasionally when life is preserved there is some permanent ill-ef eclampsia. Bouchut says: "The origin of certain permanent contra which bring on deviation of the head or other parts, retraction of the paralysis, etc., must be referred to the convulsions of the muscles. I seen several children in whom torticollis had no other cause. The dro of the upper eyelid, strabismus, irregularity of the mouth, severe contra of the limbs, often depend on this influence. These accidents are consequ of essential as well as of symptomatic convulsions."

ANATOMICAL CHARACTERS.—The morbid anatomy pertaining to ec sia is in most cases twofold: first, the pathological states which preced cause the convulsive movements; secondly, those which result from We have seen that in sympathetic eclampsia the diseases which sus causal relation are very numerous: some are constitutional, others and the latter may have their seat in almost any part of the economy d from the cerebro-spinal axis. In some cases of sympathetic eclamps immediate cause is too active a circulation, a state of hyperæmia of th bral vessels.

It has already been stated that this hyperæmia may be diagnostic young infants in whom the anterior fontanel is open. Such infants with acute inflammation of one of the mucous surfaces, often presen and rapid pulse and a convex and forcibly pulsating fontanel bef eclampsia begins. In other cases of sympathetic eclampsia the disease induces passive congestion of the brain, and this in turn give convulsions. Eclampsia occurring during the paroxysms of whoopin affords an example.

In some cases of sympathetic eclampsia the convulsive movement duced by the primary disease acting directly on the nervous system the medium of the nerves, without causing any appreciable alterati state of the cerebro-spinal axis. Thus, Barrier relates three fatal convulsions occurring in pneumonia, in none of which was there abnormal in the condition of the brain or its membranes.

The pathological state preceding SYMPTOMATIC eclampsia differs ent cases, since convulsions occur in almost every disease of the its membranes. The immediate cause of this form of eclampsi active or passive cerebral congestion, with or without effusion: i compression of the brain from various causes; it may be a deficien as excess of the cerebro-spinal fluid.

The congestion resulting from eclampsia may give rise to ext of blood and the formation of a clot. If this accident occur, ther paralysis affecting more or less of one side permanently, or grad appearing.

It may be difficult to decide whether the cerebral congestion pr eclampsia or is its result; but in those cases in which it precedes rates as a cause it is no doubt increased during the convulsive per spasmodic muscular action, by rendering respiration irregular and also leads to congestion of the lungs, and sometimes of other organ

DIAGNOSIS.—The only disease which resembles eclampsia is epi the diagnosis can ordinarily be made by recollecting the follow is most common in infancy. If it occur after the age of three is some manifest exciting cause which renders the child seriously endently of the convulsions, and prior also to their occurrence. lepsy first attacks are very often mild, the *petit mal* of writers: in s they are tolerably severe from the first; but, whether mild or y occur with no previous or coexisting sickness and with little or g.

mptoms in eclampsia and epilepsy are identical, except as the causes ia produce certain concomitant symptoms, and there is every reason that the spasmodic muscular movements proceed from an irritation e portion of the cerebro-spinal axis—to wit, the medulla oblongata. ke Niemeyer have given reasons for the belief that spasmodic novements are produced by functional disturbance of this part of s centre. I may state the following, to which I am not aware that s alluded: If the exposed medulla of an acephalous monster be pinched convulsions like those of eclampsia and epilepsy result. diseases, therefore, have a close resemblance anatomically and but by attention to the above facts they can ordinarily be dis- from each other.

t cases of eclampsia the child has fever or other pronounced symp- e primary disease, which suffice for diagnosis: but we have fre- amined epileptics in the Bureau for the Relief of the Out-door e first attacks were evidently produced by some exciting cause, eclamptic. One attack of clonic convulsions predisposes to d therefore eclampsia, if the attack be repeated a few times, not y ends in epilepsy. The convulsions, which at first are produced by cause, now occur without apparent cause.

ten difficult to ascertain the form of eclampsia, whether essential, ic, or sympathetic—in other words, to determine the cause—till onvulsions cease. This is especially true when, as is frequently he physician is not summoned till the convulsive movements begin, ecessary that he should act promptly, with but little knowledge of previous history. If there be an obvious antecedent disease, as ough or meningitis, the cause is apparent; but if the previous e been good or but slightly disturbed, it may be necessary to make one visit or examination in order to ascertain the seat and charac- cause. In the majority of cases of convulsions occurring suddenly f previous good health the cause is seated in the intestines, but l unexpected attacks may be due to the commencement of some ry affection, as pneumonia, or of a febrile disease, as smallpox. eclampsia be speedily fatal, the physician, if he examine carefully, t cases soon be able to ascertain the nature of the cause and diag- he form of the disease.

osis.—Symptomatic eclampsia is always serious. If it occur in of a cerebral disease, it indicates the approach of death, but if at ncement the patient may recover. Its recurrence, whatever the isease, is usually prognostic of death.

pathic or essential convulsions the prognosis depends on the sever- attack and on the age, strength, and previous condition of the there be predisposing or co-operating causes, as a nervous or excit- rament or dentition, the prognosis is less favorable than when such absent.

pathetic eclampsia the prognosis varies greatly, according to the he primary disease and often according to the stage of that disease. *ions occur* at the commencement of an eruptive fever, they generally subside without untoward symptoms and the fever pursues a favorable course. Eclampsia after the appearance of the eruption is premonitory of a fatal result. I have not yet known a patient with scarlet fever recover who had convulsions after the rash had covered the body, and experienced physicians of this city tell me that their observations correspond with mine. Dr. J. F. Meigs, however, relates one favorable case. If the cause of the eclampsia be located in or upon the mucous surfaces, a majority recover with judicious treatment. In convulsions consequent on pneumonia or a burn more die than recover.

The prognosis in eclampsia is more favorable if the parallelism of the eyes be retained, the pupils remain sensitive to light, and consciousness soon return. A fatal termination may be predicted if, after the convulsion, the child remain stupid, without any evidence of returning consciousness, and the pupils do not respond to light.

TREATMENT.—Fortunately, inasmuch as the physician is often required to treat eclampsia in ignorance of the cause, the same measures are demanded to a considerable extent in all cases, whether the form be essential, symptomatic, or sympathetic. As early as possible in the attack the feet should be placed in hot water to which mustard is added, or if it can be procured with little delay a general warm bath may be used in its place. This has a soothing effect upon the nervous system and promotes muscular relaxation, while it also produces derivation of blood from the cerebro-spinal axis. It is therefore useful, especially in those cases in which active or passive congestion precedes the eclampsia; it is also useful as a preventive of passive congestion and consequent œdema of the brain, lungs, and other organs, which are the most serious results of eclampsia. It should be continued from six to fifteen or twenty minutes, according to the severity and duration of the attack; at the same time cold applications should be made to the head until its temperature, which is usually increased, is reduced. The application of cloths placed upon ice or frequently wrung out of cold water is the most convenient and ready mode of employing this agent. Cold thus employed acts promptly in contracting the vessels of the brain and meninges and diminishing the cerebral congestion. It tends, therefore, to remove one of the chief dangers.

Cold applications are also useful for reducing an elevated temperature if it be present. In most cases of eclampsia, if the temperature reach 103°, the necessity for its reduction is urgent, and the cold cloths or India-rubber bag containing ice should be applied not only upon the head, but also along the sides of the face, and sometimes over the great vessels of the neck.

Since a large proportion of convulsive attacks originate in the condition of the intestines, either solely or in part, it is advisable to prescribe an aperient unless there be previous diarrhœa.

The common enema of soap and water will usually produce a free and speedy evacuation, and will sometimes disclose the cause of the eclampsia in the expulsion of seeds or other indigestible substances or scybala. A cathartic is also often required, especially if the enema fail to produce sufficient evacuations. In those that are robust, and especially in those beyond the age of two or three years, calomel is an excellent purgative, is easily given, and is prompt in its action. If the symptoms indicate intestinal inflammation, the milder purgatives, as castor oil, are preferable, as they also are in young or feeble children. If the recent ingesta of the patient consisted of fruit or of substances of an indigestible character, an emetic is appropriate; a teaspoonful of the syrup of ipecacuanha, repeated if necessary in fifteen or twenty minutes, may be given to a young child, or this syrup mixed with the syrup scillæ compositus to one older and more robust. Aside from the ejection of the offending substance which it produces, an emetic has some effect in controlling the convulsive movements. But the cases are rare in which emetics are indicated.

In addition to the local measures mentioned above, and measures calculated to relieve the digestive canal of any offending substance, a safe medicinal agent which will act promptly in relieving the convulsions is urgently demanded, since eclampsia, if severe and protracted, involves great danger. Fortunately, such agents have been lately introduced into therapeutics—namely, the bromide of potassium or sodium and hydrate of chloral. These agents, while they are effectual, are safe, and therefore their use has supplanted that of the antispasmodics, asafœtida, valerian, lavender, and chloroform, formerly employed; not one of which, except chloroform, exerts any direct controlling influence over the convulsions, and chloroform is a dangerous remedy unless used sparingly.

The bromide of potassium, which I prefer, should be given every ten minutes, dissolved in cold water, till the convulsions cease, in doses of four grains to a child of one year, and of five to eight grains to a child of two or three years. When the convulsions cease the interval between the doses should be lengthened. In one instance in my practice an infant of eighteen months was suddenly seized with eclampsia, and the mother, in her fright mistaking the directions, gave thirty grains of bromide at one dose. Two hours afterward, when I was able to attend, I found that the convulsions had ceased at once and that the patient was playful. Such cases show the innocuousness of a large dose of the bromide and the safety in administering the medicinal dose often.

In severe cases the bromide does not always act with sufficient promptness and power. The hydrate of chloral should then be employed, given by the mouth or dissolved in two or three drachms of water, and given with a small glass or gutta-percha syringe per rectum. If used in sufficient quantity *per rectum*, and retained by pressure with a napkin, it is quickly absorbed, and will usually in about fifteen or twenty minutes control the eclampsia. For a child of one year I employ about two grains, and for one of four years four grains, given by the mouth, or double this quantity given per rectum. With the use of the measures indicated above eclampsia is, in my practice, much more amenable to treatment than in former years. Unless the cause be such that recovery is impossible from the very nature of the case, the convulsions will soon cease with these measures. It is interesting to observe the effect of the chloral enema. In from five to ten minutes the convulsive movements cease in the muscles of the face, a moment later in those of the arms, and lastly in those of the lower extremities.

But additional treatment may be required, according to the pathological state which has brought on the eclampsia. If it be an eruptive fever, as scarlatina, and the eruption have receded, active revulsive measures, as hot mustard baths, are required; if in dysentery or other internal inflammation, the flaxseed and mustard poultice should be applied over the parts affected.

In those dangerous cases in which symptoms of cerebral congestion continue after the eclampsia ceases additional treatment is required. The child remains drowsy, does not speak or apparently suffer in any way, and the pupils act less readily than in health. If this condition remain after the lapse of a few hours there is probably serous effusion. All attacks of eclampsia, unless the mildest, are followed by a period of drowsiness, but the persistence of it, with symptoms which indicate hyperæmia, with perhaps effusion within the cranium, calls for the employment of additional measures. Vesication by cantharidal collodion should then be produced behind the ears, mild revulsives be applied to the extremities, the head kept cool, the bowels open, and in certain cases a diuretic like iodide of potassium may be advantageously employed. The utmost care should be enjoined in reference to the hygienic management of those who are subject to eclampsia. The diet should be nutritious but bland, and all causes of excitement be studiously avoided.

CHAPTER XI.

EPILEPSY.

Epilepsy is a paroxysmal disease. The paroxysms are manifested by impairment or loss of consciousness, and in fully-developed and typical cases also by convulsive movements of more or fewer of the voluntary muscles. Epilepsy is a neurosis or functional affection of the nervous system, not due, therefore, to any appreciable structural change in the brain or spine. The convulsions are tonic or clonic, or most frequently both, the tonic preceding the clonic.

Etiology.—In a large proportion of cases we are able to discover both predisposing and exciting causes of the first attack, but one convulsion produces such a change in the nervous system that the liability to another attack is increased. Hence after the epileptic habit is established after one or a few attacks, convulsions usually occur without any apparent exciting cause; and if such a cause be discovered, it is evidently insufficient without the presence of a strong predisposition.

Predisposing Causes.—Prominent among these is a neurotic inheritance. Echiverria, whose observations were made in the epileptic wards on Blackwell's Island, states that 28 per cent. of the 300 epileptic patients examined by himself presented evidences of inheritance. In Reynolds's cases the number was 31 per cent., and in 1218 cases examined by Gowers the number who presented evidences of an inherited predisposition was 429, or 35 per cent. The morbid state in the parent which gives rise to an inherited predisposition to epilepsy in the child is most frequently epilepsy or insanity. Less frequently, according to Gowers, the parental disease is chorea, hysteria, or a spinal malady. Inherited predisposition is said to be more frequently from the mother than from the father. The occurrence of epilepsy in a brother or sister renders it probable that the patient has inherited a predisposition, although we may be unable to trace it to either parent or any of the ancestry. The evidence of a strong inherited predisposition is sometimes apparent by the number of near relatives affected by the same disease. Thus, Gowers states that in one instance the patient's mother, aunt, two uncles, and a cousin were epileptic, and in another instance fourteen near relatives had epilepsy.

Age.—Statistics relating to the age at which epilepsy begins have been published by Haase, Gowers, and others. These show that three-fourths of the cases begin under the age of twenty years, one-fourth under the age of ten years, and about one-eighth under the age of three years.

Exciting Causes.—Immediate or exciting causes of epilepsy are usually most apparent in cases which begin during infancy or childhood. The history of a large number of epileptic children has been ascertained during the last twenty years in the children's class in the Out-door Department at Bellevue, and very frequently we were informed that at the first attack the child was feverish or constipated or had some acute ailment, which served as xciting cause. Often the first convulsions were attributed to dentition, e now know that most of the cases which are attributed by the parents thing are due to other causes, as constipation, diarrhœa, the presence of stible or irritating ingesta in the intestines, rachitis, or some acute ious or inflammatory disease. If the child have a succession of dis- giving rise to convulsions, they may be sufficient to establish the epi- habit, even when there is no apparent predisposition to epilepsy. Gowers relates the case of a child of healthy parentage and without nherited predisposition, that had a fit at the age of six months, attrib- to teething; another at the age of two years, from scarlet fever; er at four and a half years, from measles; and another at sixteen and years, from a carbuncle. These repeated convulsive attacks ended in nanent epilepsy.

ental Emotion.—Fright or great excitement, from whatever cause, is the common and potent of the immediate causes of epilepsy. It produced rst convulsive attack in 157 of Gowers's cases, or in more than one-third ose in which an exciting cause was assigned. This cause is operative y in the periods of childhood and youth, when the emotions are strong, in females more frequently than in males. Among the enumerated s of the mental excitement, authors mention fire-alarms, burglaries, thun- orms, and pretended ghosts. Gowers states that a soldier on sentry-duty ht was so frightened by some white goats that appeared suddenly on the f an adjacent cemetery that he was seized with convulsions and became ileptic. Sudden and profound emotion has sometimes been the exciting of chorea, and in other instances of epilepsy, in cases which I have ed, in one instance in an emotional child, the sight of the corpse of a te uncle producing this result. In another instance a physician of my intance, in treating a female child with scarlatinous nephritis, ordered a bath. The next day, visiting the patient and learning that his direc- had not been heeded, he prepared a bath and in a rude manner plunged ild in it. She was much frightened, and immediately had a severe con- n. The scarlatinous uræmia probably predisposed to the attack, but ight was the exciting cause. She has been a confirmed epileptic from ay, the fits being frequent and severe. Treatment employed at inter- uring the last ten or twelve years has had but little effect in controlling

Gowers states that in an aggregate of 76 cases in which epilepsy ed from fright the convulsion occurred immediately in 28, within a few in 16 others, after the first day, but within seven days, in 19, and at a eriod than one week in 13.

otracted cares or anxieties, which prevented the needed mental rest, lso in some instances been the only assignable cause of epilepsy, but ause is less frequent in childhood than in adult life.

aumatism.—Usually the injury received is upon the head, either from or a blow, by which the patient is stunned or rendered unconscious for . The convulsion may occur immediately or not until the lapse of a more. Traumatism is ordinarily attended by much mental excitement, is has its influence in producing the convulsive attack.

nong the less frequent but occasional causes of epilepsy in infancy and ood we may mention inherited syphilis, intestinal worms, scarlet fever, s, pneumonia, rheumatism, exposure to a high degree of heat, especi- the sun's rays, masturbation, renal disease, and peripheral causes hav- reflex action, as phimosis, cicatrices, and a decayed tooth. When these are removed, the clonic convulsions which they have produced may but in other instances they continue, the epileptic habit having been *shed.*

SYMPTOMS.—Two forms of epilepsy have long been recognized and described in standard treatises—the mild and severe forms, the epilepsia mitior and epilepsia gravior; or, in the French language, *le petit mal* and *le grand mal*. As the terms imply, this classification is based on the difference in the severity of the attacks.

Minor Attacks.—These are characterized by momentary dizziness and usually loss of consciousness. The patient has a bewildered look; his speech is interrupted, even in the middle of a sentence, and his work, whatever it may be, is also interrupted, so that whatever he is holding drops from his hands. His pallor, bewildered look, and strange actions attract attention, but in a moment he resumes his work and his speech. When the attack is over he may be at once in his ordinary mental and physical condition, and seem quite well, but he does not have a clear recollection of what has happened. Some patients after the attack ceases remain for a time in a drowsy state and without full perception, or their speech and acts may be passionate and violent until they regain their normal state.

Major Attacks.—These begin abruptly with strong tonic contraction of the muscles, which causes rotation of the head to one side, a fixed lateral, and sometimes upward, deviation of the eyes, and a constrained and awkward position of the extremities. The facial, thoracic, and abdominal muscles participate, causing distorted features and embarrassment of respiration. The face, at first pallid, soon becomes livid, the pupils are dilated, the conjunctiva insensitive, and the eyes are in some patients open, but in others closed. The cyanosis deepens and the surface becomes very livid. In a moment the muscles begin to vibrate and undergo alternate relaxations and contractions. The second stage, or that of clonic convulsions, begins. The head, face, body, and limbs are violently jerked, saliva tinged with blood flows from the mouth, and sometimes the urine and feces are expelled. The patient presents a striking and shocking spectacle, which gave rise in olden times to the belief of demoniacal possession. Presently the muscular relaxations become longer, more air is inhaled, and the blueness, which was intense, begins to abate. The muscular contractions, though as severe as at first, are less frequent, and finally cease, and the patient, weak and unconscious, sleeps quietly but soundly. Occasionally, instead of a simultaneous commencement of the attack in all parts of the body, it begins in one region and extends to others on the same side, and then, diminishing on this side, it begins on the opposite side. In this form of epilepsy the patient may not lose consciousness until late in the attack, so that he at first is aware of his condition, and the convulsions may be clonic from the first.

Aura.—Certain patients exhibit symptoms which are premonitory of the attack some hours before its occurrence. One of these is the sudden jerking of certain muscles, as of the arms or legs. This usually occurs when the patient is awake, but it may occur when he is asleep or is falling asleep. Another occasional premonitory symptom is persistent dizziness preceding the attack some hours or even days. A ravenous appetite, a stifling sensation in the chest, as if from want of air, numbness, cephalalgia, impairment of sight, the vision of red fiery sparks (Aretæus), and irritability of temper occasionally precede the attacks, so as to forewarn the patient and friends. Boötius in 1649 described a premonitory symptom which was observed in rare instances, but which was thought to justify the recognition of a variety of the disease that was designated *epilepsia cursiva*. The patient ran a short distance and then was seized with the convulsion. Another similar precursory symptom immediately preceding the attack is mentioned by writers. The patient, if walking, even if entering his home, turns around, retraces his steps, and falls down in the fit. The premonitory symptoms described above, which enable the epileptic, with the aid of his friends, to reach a place of safety before the attack begins, occur in a small proportion of cases.

Many epileptic fits begin with an *aura*—a term first employed by Pelops, the predecessor and teacher of Galen, to indicate a sensation which commences in some part away from the brain and ascends toward it. In olden times the aura was supposed to be a vapor, which traversed the vessels to the brain and caused the attack. It is now known that it ordinarily has a central origin, is due to commencing functional disturbance of the brain, and is a part of the fit. It is true that the immediate application of a ligature or tight band above the aura, which arrests its ascension to the brain, will often prevent the fit, but Odier, Brown-Séquard, and Gowers have shown that this occurs in epilepsy due to cerebral tumors even more frequently than in epilepsy which has no appreciable anatomical cause. Therefore, this fact of the arrest of the convulsion by ligation above the aura cannot be employed as an argument in support of the theory of the peripheral origin of the attacks.

The statistics of Romberg, Sieveking, and Gowers show that an aura occurs in about half the cases. The aura may begin in any peripheral portion of the system, in any of the organs of the special senses, and in many of the internal organs. By knowing from what portion of the brain the nerve arises which supplies the part that is the seat of the aura, we are enabled to state which of the divisions of the brain is probably so affected as to produce epilepsy.

The aura varies greatly in its character as well as location. It is a sensation of pain, numbness, burning or tingling, or instead of being sensory it may be wholly or chiefly motor, as cramps, jerking, twitching of a certain muscle or group of muscles occurring. Sometimes the aura is at the same time both sensory and motor. The sensory aura commonly ascends, as we have already stated, toward the head, but it occasionally descends a limb, and when it reaches a certain point the convulsion begins. The aura often occurs in one side of the face, tongue, or trunk, or in one limb. In other instances it is bilateral or general, commencing simultaneously in corresponding limbs of the two sides. Auræ in the trunk, and not in the viscera, occur almost entirely in the back, along the spine, and are known as the spinal auræ. General auræ are sometimes characterized by faintness, malaise, or powerlessness, or a general tremor or a general sensation of coldness or of heat. Visceral auræ occur for the most part in viscera supplied by the pneumogastric. The most common of these auræ is the epigastric, a pain or a sensation in the epigastrium, vaguely described as a "heat," "coldness," "trembling," a "twisting" or "winding up." The epigastric aura may be a little above or below or to the left of the epigastrium. In some cases the aura is located in the chest or throat. A sensation of suffocation or tingling or burning, or an indescribable feeling, is experienced in the chest or throat immediately before the attack begins. The patient perhaps presses upon his chest or throat with his hands and immediately becomes convulsed. The heart also derives its innervation from the pneumogastric, and the aura is sometimes referred to this organ. In some patients the cardiac region is the seat of a vague sensation variously described, or the aura may be manifested by increased action or palpitation, with perhaps more or less dyspnœa. Of the cephalic auræ, vertigo is perhaps the most common, attended in some by rotation of the head and occasionally of the body. In certain epileptics there is the sensation of rotation without actual movement, and in some instances objects seem to move. Cephalic auræ in a considerable number of instances consist of headache or a sensation in the head described as heaviness, pressure, coldness, burning, etc.

In certain cases the auræ are entirely emotional, having usually the form of fear, which is sometimes so great that extreme terror is depicted on the countenance, and yet there may be no remembrance of it after the convulsion is over. In a considerable number of instances the auræ are manifested in the organs of the special senses, and consist in an aberration of their functions. The olfactory aura is usually an unpleasant smell, as of sulphur, putrid matter, pus, decaying animal substances. The gustatory aura is a bitter, sour, metallic, or nauseous taste. The ocular aura is an unusual sensation in the eye—diplopia, an apparent change in the size of objects viewed, sudden blindness, or the perception of unusual or striking objects, as a flash, sparks, colored lights, or persons or things not present, sometimes quiet, sometimes in motion. The auditory sensations occurring as auræ are sounds of many kinds—of music, of bells, thunder, a whistle, the wind, an explosion or any other startling sound. It is seen that the auræ, although having a central origin, occur in almost every part of the system, remote from as well as near the brain, and are of many different kinds.

In some epileptics a harsh scream or groan announces the commencement of the fit, but in children, according to my observations, it rarely occurs. It is apparently produced by a spasm of the laryngeal muscles, which causes narrowing of the passage through the larynx, and a spasmodic contraction of the thoracic and abdominal muscles, which causes a rapid and forcible expiration. The patient is unconscious of the scream, or he may be conscious of it, but unable to prevent it.

In the fit, when of ordinary severity, consciousness is early lost, and it does not return until the somnolence which follows the attack has abated; but in the mild disease, the *petit mal*, the patient, though confused, often retains consciousness during the attack. In the *grand mal* the attack begins with a tonic spasm of the muscles, causing rotation of the head and deviation of the eyes to one side. Sometimes there is rotation of the entire body, so that the patient turns around one or more times before he falls. The position of the limbs during the tonic spasm varies. Commonly the arms are slightly abducted, the forearms flexed to a right angle, the hands flexed at the wrists, the fingers flexed on the hands, but extended at the other joints, and the thumb is pressed upon the palm or fore finger. The legs are ordinarily extended, but the legs as well as arms may assume different positions.

Clonic convulsion, or the second stage of the attack, supervenes in a few seconds or after two or three minutes. The tonic spasm relaxes gradually, and the clonic spasm supervenes gradually. The clonic convulsion or alternate contraction and relaxation, rapidly succeeding each other, occur in the muscles of the face, tongue, palate, and larynx, as well as in the muscles of trunk and extremities. The tongue is frequently bitten, both in the tonic and clonic spasms, so that the blood oozes, and, mixed with frothy saliva, exudes from the mouth. The pupils are dilated during the attack, and they do not contract by light. As soon as consciousness begins to return, the pupils begin to contract and respond to light. Exceptionally, at the close of the fit the pupils alternately contract or dilate at intervals of one or two seconds, and, as already stated, the conjunctiva loses its sensitiveness, so that it can be touched without producing reflex action of the orbicularis. Relaxation of the sphincters also often occurs during the fit, so that fecal and urinary evacuations take place.

The pulse may be normal or rather feeble in the beginning of the attack, but its frequency, and sometimes its fulness, increase during the muscular spasms. The features, usually pallid, but sometimes flushed at the beginning of the attack, become congested and even cyanotic in less than a minute. The congested and livid features present an alarming appearance, and frequently the general surface is bathed in perspiration before the attack ends. Ophthalmoscopic examination of the eyes during the convulsion is difficult, but during the cyanotic stage the retinal vessels have been seen presenting an engorged and dusky appearance. Gowers states that in one instance, in which fits occurred in rapid succession during several days, he observed congestion of the discs with slight œdema, which disappeared after the attacks ceased. In the intervals of the paroxysms nothing has been noticed in the appearance of the eyes which throws light on the nature of the disease. The duration of the second stage of an epileptic fit or that of clonic spasms varies from a minute or two to a considerably longer time. When it ceases the patient passes into a sleep or deep stupor, which continues a quarter of an hour or longer. If aroused from the stupor he complains of severe headache, and this continues often for hours after the stupor ceases.

Languor and muscular weakness are common after the fit, and they gradually pass off. When, as occasionally happens, paralysis occurs after the fit and continues for weeks or permanently, organic cerebral disease is present, either preceding and causing the fit or resulting from it. If no paralysis or cerebral symptoms have preceded a fit, and it is followed by paralysis of one or more of the extremities, it is highly probable that intracranial hemorrhage has occurred during the attack. Todd, Hughlings Jackson, and others attribute the muscular weakness following an epileptic attack "to exhaustion of part of the brain by the excessive action," but protracted or permanent loss of muscular power in an epileptic having good general health indicates organic disease in the brain.

The above description relates to epilepsy as it ordinarily occurs, but there are many cases which vary from the typical form. Tonic convulsions may occur without the clonic, and clonic convulsions without the tonic, and the convulsions, instead of being general, may be limited to a limb or to one region of the system. Of 155 cases of minor epilepsy, Gowers states that in 45 the disease was indicated by momentary attacks of unconsciousness, faintness, or sleepiness; in 25 by dizziness; in 17 by sudden jerking of head, trunk, or limbs; in 17 by loss or aberration of sight; in 8 by a mental state, as sudden and extreme fright; and in the remaining 42 by sensations of various kinds or momentary rigidity or by tremors or twitching occurring in some part of the system. Automatic movements sometimes occur during the stage of unconsciousness which succeeds the attack, and the attack may be so light that it is not noticed by the bystanders. Gowers relates several such instances. Some patients begin to undress themselves, whatever the surroundings; others make the motions of walking up stairs, although no stairs are present; some put in their pockets any near object, without regard to its nature or ownership. Trousseau states that an architect during the state of unconsciousness ran from plank to plank on the scaffold where he was at work, shouting his own name. One of Gowers's patients during the unconscious state laughed and sang; another threw her infant down stairs; a girl of twenty kissed every object within her reach; and a man struck his friend a severe blow. Many supposed criminal acts have been perpetrated by unconscious epileptics, for which they have been severely punished.

ANATOMICAL CHARACTERS.—No information has been obtained in regard to the etiology and nature of idiopathic epilepsy by a study of its anatomical characters. If the patient have died in the attack, intense venous congestion is observed of the cerebro-spinal axis as well as of other parts, but in recent cases nothing else abnormal has been detected in the brain or elsewhere. The thickening and opacity of the cerebral meninges sometimes observed in chronic cases, and the induration of the pes hippocampi described by *Meynert, are now* believed to be results of the repeated attacks, and not their cause. Structural change in the brain in idiopathic epilepsy, if there be such, which sustains a causal relation to the attacks, has thus far eluded detection by the microscope.

Pathology.—Epileptic attacks are believed by neuropathists to be due to a sudden and exaggerated functional activity of nerve-cells in some part of the brain. The theory at present accepted is that these cells generate a nerve-force which, transmitted along the nerves, stimulates the muscles to spasmodic contraction. In regard to the part of the brain in which these overacting cells reside, we may state that Brown-Séquard and Kussmaul demonstrated that convulsions may be produced by irritating the pons and medulla when every other part of the encephalon lying above these is removed. Convulsions can also be produced in acranial monsters, as I have stated above, by irritating the exposed medulla and pons. Nothnagel has also shown that there is a "convulsive centre" in the medulla oblongata. On the other hand, injuries of the convolutions more frequently cause convulsions than do those of any other part of the brain, and Wilks and others have taught that in ordinary epilepsy the part of the brain which is most frequently in fault, so as to cause convulsions, is the superficial portion of the convolutions. Still, the exaggerated production of nerve-force which causes the convulsions may be at a greater depth than the convolutions, even when the attacks are due to traumatism, since, as Burdon-Sanderson has shown, nerve-cells more deeply seated than the convolutions may be stimulated to increased functional activity by injuries of the superficial regions. Therefore, Nothnagel, aware of the fact that injuries of the cortex often cause convulsions, states that he sees no reason to modify his opinion that the exaggerated production of nerve-force which causes the convulsions is in the "convulsive centre in the medulla oblongata." The above observations seem to indicate that epileptic attacks do in some instances originate in the convolutions or hemispheres, and in others in the medulla.

Recently, Gowers and others have endeavored to determine in what part of the brain the nerve-force resides which causes the convulsions, by studying the auræ. Since the auræ have a central origin and are the first manifestation of the exaggerated action of the nerve-cells, the attempt is made to determine the location of these cells by observing the nature and the seat of the auræ. Gowers says that one-fifth of the auræ pertain to the special senses, and the nerve-centres of these senses "are certainly situated within the hemispheres, above the pons." Therefore, the inference is inevitable that in these cases the discharge of nerve-force which stimulates the muscles to spasmodic action is in the hemispheres. Moreover, a fit that is preceded by an emotional or mental aura, we infer, originates from the nerve-cells of the hemispheres which are the seat of the mind. The theory is therefore plausible and apparently sustained by clinical observations, that in at least some instances the epileptic centre in the brain is in the hemispheres, though it may in other instances be at the base of the brain—in the medulla or pons.

What occurs in the brain to produce the phenomena of epilepsy? It is the belief of many specialists in nervous diseases that epilepsy results from suddenly developed cerebral anæmia produced by spasmodic contraction of the arterioles. It is also the belief of some that the primary discharge of nerve-force occurs in the medulla at the vaso-motor centre, and that this is followed by spasm of the arterioles in the hemispheres, by which consciousness is lost. That cerebral anæmia is present is inferred from the fact that the features are usually pallid when the attack commences. But in many instances, especially in epilepsy of a mild type, no pallor or other sign of peripheral anæmia is present, and in such cases there is no evidence whatever of cerebral anæmia. Besides, as Gowers has forcibly stated, pallor of the features does not necessarily indicate cerebral anæmia, any more than flushing of the face indicates cerebral hyperæmia. In experiments on frogs irritation of the brain causes contraction of the peripheral arterioles. Probably in the same manner, says Gowers, the contraction of the peripheral arterioles and the pallor result from the irritation of the brain occurring in the first stage of the fit. That cerebral anæmia occurs in the attack, and that it sustains a causal relation to the phenomena of epilepsy, are assumptions destitute of proof.

As to the pathology of epilepsy, we have said or have intimated that it is the belief of the majority of those who from large clinical experience are most competent to express an opinion that the epileptic attacks are produced by a hyperactivity of nerve-cells in the gray matter in some part of the brain, and an increased discharge of nerve-force, which stimulates the muscles to spasmodic action. The spinal cord and the nerves are implicated as carriers of this nerve-force. Farther than this we are unable to express any theory in the present state of our knowledge.

DIAGNOSIS.—In a considerable number of instances nocturnal epilepsy is entirely overlooked. Some patients awaken at the beginning of the attack, and have subsequently a vague recollection of its occurrence. Others are aware of the fit by subsequent signs or symptoms, as a bitten tongue, blood on the bed-clothes, a swollen and ecchymotic face, conjunctival extravasation, and perhaps evacuations in the bed. In children nocturnal epilepsy is more likely to be detected than in adults, since they are more closely watched. Gowers states that he has known it to occur twenty years without being suspected. In mild epilepsy the symptoms may escape the notice of friends, and when observed by the patients and friends their import is often misunderstood. Those suffering from *petit mal* are in many instances supposed to have attacks of faintness. The differential diagnosis between epileptic vertigo and syncopal faintness is made by the fact that in the latter the previous health has usually been poor, the action of the heart feeble, and there is some exciting cause of the sudden cardiac weakness; whereas in epileptic vertigo such conditions do not, as a rule, exist. In epileptic vertigo there is no premonition except the aura, which is momentary, and recovery or return to the normal state is rapid. Syncope, on the other hand, begins and ends in a more gradual manner.

The symptoms of eclampsia and epilepsy are identical as regards the convulsive movements. We designate by the term "eclampsia" those attacks which are due to local or general causes, which do not recur when these causes are removed, and the occurrence of which, whatever the causes, is limited to a brief period. But, as we have seen, one attack of convulsions predisposes to another, and one or more convulsive fits that are eclamptic frequently establish the convulsive habit, so that epilepsy results. In a large proportion of the cases of eclampsia the convulsions have a reflex origin. They are produced by causes located at a distance from the brain and affecting the nervous centres, causing convulsions through the medium of the nerves. Painful and swollen gums in dentition, constipation, irritating ingesta, intestinal worms, scarlet fever, nephritis with albuminuria, are among the common causes of eclampsia. In recent convulsions, when such causes are present, the diagnosis of eclampsia will be proper in the great majority of instances, and the attacks will cease and not recur when the apparent causes are removed. Gowers regards rickets as a common cause of eclampsia in young children, and remarks that when this diathetic state is cured by "cod-liver oil and steel wine" the convulsions no longer occur; but if proper treatment be not employed, if the rickets continue, and with it the frequent convulsive attacks, the epileptic habit may be established and epilepsy continue during the remainder of life.

PROGNOSIS.—Epilepsy is rarely fatal, although the symptoms are appalling to one who has not previously witnessed an attack. Asphyxia occasionally occurred by the patients falling in water during the fit. A little depth of water with the face downward is sufficient to cause f obstruction to inspiration. Therefore, not a few epileptics die by drowni If the patient roll upon the face during the fit, or vomit, he may be asphyx ted by the bed-clothes or by the entrance of particles of food in the laryn

The spontaneous cessation of the epileptic fits and spontaneous cure o epilepsy rarely occur, since each attack tends more strongly to establish th epileptic habit. Fortunately, since the therapeutic uses of the bromides have become known epilepsy has frequently been cured. In infancy and childhood, in the majority of instances, epilepsy is rendered milder, so that the fits occur at longer intervals, even if entire cure be not effected. Moreover, the prospect of curing epilepsy is better in children than in adults, in accordance with the law that the shorter its duration and the fewer the attacks which have already occurred the more amenable it is to treatment. Epilepsy in which several days intervene between the attacks is, as might be expected, more likely to be benefited by treatment than when the attacks are frequent. If the mind be not perceptibly impaired, if the fits are uniformly severe, instead of some being severe and others mild, if they occur only during sleep or only during wakefulness, and if hemiplegia be absent, the prognosis is better than when the reverse is the case. In ordinary cases of epilepsy in childhood the attacks immediately become less frequent by the bromide treatment. If a sufficient amount of the bromide be administered three times daily, months often elapse before a recurrence of the attack; but if the remedy be discontinued after six months or a year in the belief that the patient is cured, a recurrence of the disease is probable. A patient cannot be pronounced cured until three years have elapsed without any symptoms.

TREATMENT.—No mode of treating epilepsy which will effect an immediate cure has yet been discovered, nor is it probable that such success of treatment will ever be obtained. Cure is effected by treatment which diminishes the hyperactivity of the nerve-cells that are in fault, and prevents the exaggerated production of nerve-force. Medicines designed to effect this object must be given daily for a prolonged period, since their use for a few days or weeks does not suffice to produce the desired change in the nerve-centre.

Since the bromides have come into general use in the treatment of nervous diseases, the first place is universally accorded to them among the remedies for epilepsy. The bromides of potassium, sodium, ammonium, and lithium have probably nearly the same effect, but the potassium and sodium bromides are usually prescribed. No advantage results from the use of bromine or hydrobromic acid, even if it were safe and convenient, for it becomes a bromide as soon as it enters the alkaline blood (Gowers). All the bromides produce acne, but this can be prevented to a considerable extent by the simultaneous use of arsenic in small doses. The bromide should be given daily for weeks or months in the smallest dose which is found to arrest the fits or, if it do not entirely arrest them, produces the most decided effect upon them. If the fit occur at a certain hour, one daily dose, administered previously, may suffice to prevent it, but usually it occurs irregularly, and a morning and evening dose or three daily doses are required. Bromism, indicated by a weak pulse, cold extremities, and mental and physical dulness, has never, according to my observations, seriously interfered with the treatment. During my long connection with the children's class of the Bureau for the Relief of the Out-door Poor at Bellevue almost every week new cases of epilepsy have been presented for treatment, and it has seldom been necessary to discontinue the use of the bromide on account of bromism. A girl had her first attack of clonic convulsions at the age of four months. When she reached the age of three years and a few months she began to have attacks of the *petit mal*, manifested by pallor and an epigastric aura, followed by sleep lasting one or two hours. These attacks occurred at irregular intervals. In her fourth year she had measles and scarlet fever. In her seventh year she came under observation. A strict milk diet was ordered, and she took one teaspoonful in the morning and two at night of the following mixture:

℞. Sodii bromidi, ℥iiiss;
Aquæ, ℥xvj. Misce.

This treatment was continued with scarcely an interruption during her seventh, eighth, and ninth years, with complete cure of the disease and with bromism only on one occasion. Gowers, writing of adults, remarks that few patients can take more than one and a half drachms of the bromide daily without bromism. But, according to my observations, children can take larger proportionate doses than this without injury. Although prescribing the bromide of potassium daily for children of all ages during many years, I have seldom observed any ill effects which were clearly attributable to its use except the occurrence of acne. Bromism soon disappears when the dose of the bromide is diminished or its use is discontinued. In general, this medicine should be given twice or three times daily during as long a period as two years after the last paroxysm, without diminishing the dose which is found sufficient to cure the disease; and, to make sure of a cure, it should be employed a third year in a gradually diminishing dose. In the case related above the patient, a girl then at the age of nine years, had taken the bromide of sodium two years in two doses of thirteen and twenty-six grains with complete arrest of the attacks, when she had symptoms of bromism. The bromide was discontinued, and she remained well for some weeks, but finally she stated that the furniture at times seemed to move. Half the previous dose was now employed for a month or two, when it was discontinued, and she has remained well without medicine during the six or eight months which have since elapsed. In slight bromism during the first and second years of treatment it is usually better, I think, to diminish the dose of the bromide; but not to discontinue its use, and at the same time to employ a vegetable tonic with alcohol. In great cerebral depression due to the bromide, it is probably better to entirely discontinue its use for a time, even if convulsions occur.

Occasionally, the bromide employed alone does not cure epilepsy. It may then be given in combination with another drug which is believed to exert some controlling influence upon the disease, as digitalis, belladonna, cannabis indica, or zinc. These remedies were prescribed with apparent benefit in at least certain instances before the bromides came into use. Digitalis has been employed as a remedy for epilepsy since Parkinson recommended it in 1640. It is not very efficient when used alone, but in some instances when given with the bromide it evidently increases the curative power of this agent. Gowers says: "In many cases attacks which continued on bromide only ceased entirely on bromide and digitalis." He observed good results from the use of this combination, especially in epileptics who had cardiac disease, as dilatation, valvular insufficiency, hypertrophy, and a too rapid pulse. Benefit also occurred in some instances in which the heart's action was normal, as in the following case: Jesse ——, aged twelve years, was when an infant rachitic, backward in teething and the use of his limbs. He had the first epileptic fit at the age of sixteen months. The attacks occurred at intervals of one week, and were preceded by a visual aura, a red ball of fire, that approached the eye. Fifteen grains of the bromide of ammonium, with five minims of the tincture of belladonna, were prescribed, to be given twice, and subsequently three times, daily. With this treatment the intervals between the fits were lengthened to one month, but they still occurred after six months' treatment. Five minims of the tincture of digitalis were then substituted for the belladonna, and no fit occurred for eleven months. On diminishing the dose of digitalis, one fit occurred, but on resuming its use in five-minim doses seven months elapsed without an attack. A girl of eighteen years had a convulsion at the age of two years, another at seven years, and confirmed epilepsy since her tenth year. The attacks occurred about every second day, without an aura. The bromide alone and bromide with belladonna were employed, with slight diminution in the frequency of the attacks. Digitalis with the bromide was then employed. Immediately the fits were reduced to four, then to two, in the month, and then four months elapsed without a fit. A girl aged eleven years, greatly frightened by a thunderstorm, began to have nocturnal epileptic attacks. At the age of fourteen years, when treatment was commenced, the attacks occurred nearly every night. One scruple of the bromide of potassium and ten minims of tincture of belladonna reduced the attacks to one in ten days. Then the treatment was changed to two scruples of bromide of ammonium and five minims of tincture of digitalis, taken once daily at night, and two months passed without an attack, when she was lost sight of. These cases, to which more might be added, show that digitalis combined with the bromide increases the efficacy of the latter in certain cases.

Belladonna has been employed in the treatment of epilepsy during the last two centuries. It was recommended by Mardorf in 1691, and by Hufeland, Stoll, and others in the eighteenth century. Its proper use is in combination with one of the bromides when the latter is inadequate to arrest the attacks. Used alone, it does not cure epilepsy, though occasionally it renders the attacks less frequent. But Gowers relates cases which show that it increases the efficiency of the bromides in certain cases when combined with them. It is believed to first stimulate and then depress the functions of the nervous system, acting not upon one part only, but upon various parts of brain and spinal cord, affecting their functional activity. To show the effect of the combination of belladonna with the bromide, Gowers relates the case of a boy in whom epilepsy commenced at the age of thirteen years without known cause. The attacks began usually in the morning without an aura, at intervals of three weeks. Fifteen grains of the bromide administered night and morning reduced the attacks to one a month. After three months of treatment twenty grains of the bromide and five minims of tincture of belladonna were given three times daily, and two months elapsed without an attack, when two occurred. Subsequently, he took the same medicine fourteen months without an attack, when treatment was discontinued. Six months later he was still well. Other cases have been related in which belladonna, combined with the bromide, produced a more decided curative action than the bromide employed alone; but in some instances, as we have seen, when these two agents fail to cure this result is accomplished by the bromide and digitalis. The liquor atropiæ, one minim of which contains $\frac{1}{120}$ of a grain of atropine, may be used in place of the tincture of belladonna.

Stramonium, cannabis indica, and gelsemium sempervirens have been prescribed with some apparent benefit in certain instances, but it is the common belief with those who have employed them that they are no more efficacious than digitalis and belladonna, and they seldom if ever cure the disease when used alone. When employed with the bromide, good results have followed, but the improvement has probably been due almost entirely to the bromide.

Zinc has been recommended in the treatment of epilepsy for more than a century by good observers. In experiments on animals it has been found to diminish reflex action, and it exerts some controlling effect on the functions of the hemispheres and the medulla oblongata. It diminishes the frequency of the epileptic attacks in many patients, but not usually so certainly as the bromides, or to such an extent. In exceptional instances zinc prevents the epileptic attacks to a greater extent than the bromide, especially when they present the hysteroid form. The oxide, lactate, and citrate are commonly prescribed, and a child of eight years can take from one to two grains three times daily. It should be given after the meals, since it sometimes irritates the stomach and causes nausea. It is believed by Gowers to be slowly converted into the chloride in the stomach. He relates the case of an adult epileptic who took five grains of the oxide of zinc morning and evening, and had no attack during the five months in which he was under observation. A girl of eight years having inherited epilepsy, after four months of treatment with the bromide was still having two fits each week. Oxide of zinc in doses of three grains was ordered, and in two months the fits ceased. Nine months elapsed with only one attack, when the patient was lost sight of. Gowers also relates the following case, showing that the addition of the zinc to the bromide sometimes plainly increases the efficiency of the latter: A boy of eleven months, belonging to an epileptic family, had a fit at the age of eleven months. At the age of fourteen years, when he was presented for treatment, the convulsions occurred every two weeks. One scruple of bromide of ammonium administered three times daily caused some improvement, as did the bromide with digitalis, but the disease was not cured until the zinc was employed with the bromide. In obstinate cases, therefore, zinc is sometimes useful as an adjuvant to the bromide.

Opium, or its alkaloid morphia, has been long employed in the treatment of epilepsy, but its use has now given place, for the most part, to that of other remedies. Occasionally, especially in the hysteroid forms of epilepsy, morphia given at the commencement of the warning has apparently prevented the fit.

The effect of iron in epilepsy is equivocal and uncertain. Brown-Séquard and Jackson discountenance its use, as they think it increases the frequency of the attacks. Gowers says that he has given iron to several hundred epileptics, and that it only rarely increases the severity of the fits. In most instances it produces no ill effect, and it sometimes improves the general health. He states that occasionally bromide with iron arrests the attacks when the bromide alone has little effect.

A considerable number of remedies which we have not mentioned have been employed, but they have been for the most part discarded by recent observers, either because they have been found to be inert or have been useful only in rare cases, and less useful than other remedies.

According to my observation, the treatment which has been found adequate to arrest the fits should be continued at least two years after the last paroxysm, being omitted for a few days or its quantity reduced if symptoms of bromism occur. Even after a cure for two years occasional symptoms of the *petit mal* may occur, so that it will be necessary to resume the use of the medicine in smaller doses.

Hygienic Treatment.—It is necessary that an epileptic child should lead a quiet and regular life, free from excitement and all perturbating influences. The diet should be plain and easily digested. In some instances a diet consisting almost entirely of milk has seemed to be a very important remedial measure.

CHAPTER XII.

INTERNAL CONVULSIONS (SPASM OF THE GLOTTIS; LARYNGISMUS STRIDULUS).

YOUNG children are liable to temporary suspension of respiration, induced by violent emotions, especially by anger. In the midst of their excitement, while they are crying or screaming, their breath is suddenly held, as if from tonic spasm of the respiratory muscles. In a few seconds respiration returns and is natural. There is no stridulous inspiration or other unusual sound, and there is no apparent ill-effect, unless occasionally a degree of languor. External convulsions, which seem to be threatening, seldom occur, and when they do are ordinarily mild. Some writers consider dentition the predisposing cause of this arrest of respiration by inducing a sensitive state of the nervous system. Such an effect of dentition is possible, but certainly many infants are affected in this manner before the age of dentition.

A much more serious state, and one which is recognized as a true disease, is that variously designated by writers as internal convulsions, spasm of the glottis, child-crowing, laryngismus stridulus, etc. Manifest difficulties attend the investigation of the pathological state in this disease. There can be little doubt that it is not precisely the same in all cases. That there is, during the paroxysms, tonic or clonic spasm of more or fewer of the respiratory muscles is inferred not only from the symptoms pertaining to the respiratory apparatus, but from the fact that in severe cases spasms of the external muscles, as those of the limbs and face, often occur. Usually, also, the movements of the eyeballs indicate spasmodic contractions of the motor muscles of the eyes. The fact of spasmodic muscular action in parts that are visible justifies the belief that it occurs in other parts which are concealed from view, especially as the characteristic symptoms cannot be readily explained except on this supposition. Trousseau says: "Internal convulsions consist, then, principally in a spasm of the diaphragm and of the respiratory muscles of the abdomen and chest; but it occurs also that the muscles pertaining to the larynx are affected with spasm at the same time with these." Rilliet and Barthez conclude from the symptoms that the "heart is not always a stranger to this internal convulsion, which perhaps prolongs itself even to the intestines." The muscles of the pharynx appear to be involved in some cases, as well as those of respiration, rendering deglutition difficult. In one form of internal convulsions—namely, that which is principally referred to by writers—there is not complete arrest of respiration, but the inspirations during the paroxysms are difficult and are attended by a stridulous noise. Again, the respiration may cease entirely, but when it commences it is stridulous and difficult during a few inspirations. In still another form of the disease respiration ceases, but there is no symptom or sign indicative of glottic spasm or of an obstacle to the ingress of air; the inspirations which succeed the paroxysm are easy and noiseless. It has been suggested that in these cases there is paralysis rather than spasmodic contraction of the respiratory muscles; but the symptoms may be explained in accordance with the commonly accepted opinion—namely, that there is spasm of the diaphragm and perhaps of certain muscles of the chest and abdomen, while the laryngeal muscles are not affected. M. Herard, indeed, who has written one of the best monographs on internal convulsions, describes three forms of the disease according to the supposed location of the spasm—namely, laryngeal, diaphragmatic, and another which consists of a blending of the two.

Internal convulsions are not frequent in this country; they are rare in France, more frequent in Germany, and quite common in England. They occur, with few exceptions, before the age of two years. Dr. West observed 31 cases under the age of two years, and only 6 above that age.

CAUSES.—The causes of internal convulsions are not fully ascertained. Most observers have remarked the relative frequency of the disease during the period of dentition, and it is probable that dental evolution does operate as a cause by rendering the nervous system more impressible.

Spasm of the glottis has been attributed to enlargement of the thymus gland, and also to enlargement of the cervical and bronchial glands. It is presumed that this effect is due to the pressure of these glands on the par vagum or the recurrent laryngeal nerve. It is certain, however, that there is no such enlargement of the thymus gland which could possibly produce glottic spasm or any other form of internal convulsion at the age at which these convulsions commonly occur. This gland is largest in the new-born, and, having no function after birth, it gradually becomes atrophied. If an enlarged thymus could produce glottic spasm, it would certainly occur most frequently in the new-born. Abnormal development of the thymus gland seemed to be the cause of atelectasis in two infants who died soon after birth in my practice, but I have not seen a case in which a convulsive attack was referable to this cause. M. Herard examined the thymus gland in 6 children who died of internal convulsions and in 60 who died of other affections, and was not able to discover in its condition any causal relation to this disease. Indeed, cases have been reported in which the thymus had undergone more than its usual atrophy at the time when the convulsions occurred (Haase). Enlargement of the lymphatic glands in the vicinity of the pneumogastric or recurrent laryngeal nerve may possibly give rise to glottic spasm, but this is doubtless an infrequent cause, if it be a cause at all, since these glands are often greatly enlarged in strumous and tubercular diseases without such a result. According to Dr. Jacobi:[1] "In some cases described by Dr. Friedleben a congenital hypertrophy of the thyroid gland has probably been the cause of laryngismus. The patients were new-born infants of normal development and born by normal labors. There were no constitutional causes of the disease, but a remarkable vascular swelling of the thyroid gland. Whenever the swelling increased the veins of the face and head increased in size also, the face grew livid, and the extremities and spinal column exhibited slight tonic convulsions. The recurrent nerves were entirely surrounded by the glandular tissue, their neurilemma looked unusually red, and their functions were probably injured during the occasional swelling taking place during lifetime" (Jacobi).

The cause is occasionally located in the cerebro-spinal axis. Thus, Dr. Coley relates a case in which an exostosis arising from the internal surface of the occipital bone pressed upon the cerebellum, while nothing abnormal was discovered in other organs. Examples are also related in which the cause was located in the spinal cord. Thus, Marshall Hall relates the case of a child with spina bifida who was attacked with croup-like convulsions whenever it lay so as to press on the tumor.

Internal convulsions are also frequent in rachitic softening and absorption of the calvarium, since, when this is present, undue pressure occurs upon the brain by the weight of the head of the child upon the pillow.

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[1] *N. Y. Jour. of Med.*, Jan., 1860.

In some patients there is evidently an hereditary predisposition to this disease, those affected belonging to families in which a tendency to convulsive maladies is manifested. Thus, Toogood states that five infants of the same family were affected with spasm of the glottis; and Reid relates, on the authority of Powel, that of thirteen infants of the same parents only one escaped internal convulsions.

The common predisposing cause is an excitable state of the nervous system, often associated with impaired general health. Hence the disease is more prevalent in cities, where antihygienic conditions abound, than in the country. Hence, too, the frequent improvement when the patient is removed to the pure and bracing air of the country. The use of insufficient food or food of a bad quality must for the same reason be considered a cause, since it leads to impoverishment of the blood and renders the nervous system more impressible. Facts mentioned by Reid and others show conclusively the influence of premature weaning and the use of indigestible or otherwise improper aliment in the production of this disease.

The causes enumerated above are for the most part predisposing; occasionally they are the only apparent causes, since this disease sometimes occurs when the child is tranquil, even in the midst of quiet sleep or when it is at rest in its mother's arms. In other cases and more frequently there is an exciting cause, often trivial. Anything that requires exertion on the part of the infant or that excites strong emotions may be a direct cause, as anger or any of the violent passions; so may even coughing, or, in rare instances, attempts to swallow. One author has known it to occur from excitement produced by examining the throat with a spoon. In a case of my practice, hereafter related, it occurred whenever the infant cried violently. It appears from the above facts that the etiology of internal convulsions is very similar to that of eclampsia. The same spasmodic muscular contraction may occur from a variety of causes.

ANATOMICAL CHARACTERS.—While, therefore, structural changes in various parts of the system may give rise to internal convulsions, this disease, so far as ascertained, presents no anatomical characters, and must consequently be considered one of the neuroses. The lesions of the respiratory apparatus which are seen at post-mortem examinations are due to the convulsions or are coincidences. Emphysema has sometimes been observed as a result, it is believed, of the spasmodic and irregular respiration. It was present in all of Herard's cases, and Rilliet and Barthez consider it common in those who die of this affection, although they did not observe it in any of their cases. Slight emphysema in the upper lobes is, however, a common lesion in feeble infants, whatever the diseases of which they die. Therefore its occurrence in internal convulsions is probably due more to molecular change in the lungs, since these patients are cachectic, than to the irregular breathing, which is only momentary.

In fatal cases of internal convulsions the blood is darker than usual, from an excess of carbonic acid; and in some cases the cavities of the heart and large vessels are engorged with blood, but in others they contain no more than the normal amount. More or less passive congestion occurs in the internal organs; and congestion of the cerebral vessels is in some patients so great that transudation of serum occurs.

SYMPTOMS.—I have said that the symptoms vary according to the seat and function of the muscles which are affected. There is generally previous ill-health. The child is drooping, and is sometimes restless, for days before the disease appears. Finally, if the muscles of the glottis become affected, the peculiar crowing sound is heard now and then during inspiration. It is observed especially when the child is crying or is agitated. It may be loud defined from the first, but in most patients it comes on gradually, several days elapse before its full stridulous character is developed. acks are more frequent and severe at night, in or after the first sleep, day-time.

der favorable hygienic conditions the malady may pass off without ng more serious. In other cases the paroxysms gradually increase uency and severity. The dyspnœa in the attack is such that the fea- re livid, the head forcibly retracted, and death seems imminent from In these severe paroxysms respiration often ceases entirely for a t. When the spasm ends a deep stridulous inspiration occurs, after the breathing is natural. I have stated also that internal convulsions en associated with those—usually tonic, but sometimes clonic—of the al muscles. In the tonic form the thumbs are flexed across the palms hands, and sometimes are grasped by the fingers; the great toes are ted and the other toes flexed. In severe cases the hands, forearms, feet, gs are also somewhat flexed and rigid. At first the contraction of the nal muscles is temporary, either corresponding with the internal spasm, is most intense at the time of the spasm, though commencing sooner and ding later. After a while, however, if the disease continue, the spas- ic action of the external muscles becomes more persistent. In severe s nearly every inspiration is accompanied by the whizzing sound, and the oxysms of dyspnœa are excited by trifling causes. Anything that sud- nly disturbs the mind or body may bring on the attack, as anger, the pression of cold, or currents of air. Dr. West calls attention to the fact at an anasarcous condition is sometimes present, accompanied by albumi- uria.

If the convulsions affect other muscles, as the diaphragm or the pectoral nd abdominal muscles, which are concerned in the respiratory function, while those of the larynx escape, respiration is irregular, or even suspended or a moment, but the stridulous laryngeal sound is absent, as there is no bstacle in the larynx to the entrance of air. In this form of the disease he inframammary region may be strongly retracted during the paroxysm rom tonic contraction of the diaphragm. In severe paroxysms, whether the pasm be laryngeal or diaphragmatic, consciousness is nearly or quite lost, the eatures may be pallid, or, if respiration be suspended, may be more or less ivid. Relaxation of the sphincters of the bowels and bladder, with invol- ntary evacuations, often occurs in this disease during the attack.

The duration of the paroxysm may be a quarter, a half, or even a whole inute. Total suspension of respiration for even half a minute involves anger. In mild cases there may be but few paroxysms, and they slight. n other instances they occur in a severe form almost daily for several weeks r even months. In the following case the muscles of the larynx were appa- ently not involved. The patient was scrofulous, and has since had scrofu- ous periostitis, with necrosis and exfoliation of the surface of the tibia. At he time of the internal convulsions she had, as seen by the history, a scor- utic or hemorrhagic cachexia:

CASE.—On the 28th of August, 1858, a German female infant, fourteen nonths old, nursing and having eight teeth, was suddenly seized with clonic onvulsions. Uniformly delicate and pallid, she had been in her usual health ill the age of twelve months, when she had a single convulsive attack, and from hat date had remained well till August 27th, when, without any premonitory ymptom, she had a stool consisting of almost pure blood, black and offensive. On the morning of the 28th a similar evacuation occurred, and another in the fternoon immediately preceding the convulsion. Pulse 128 after the convul- ion; surface cool and pallid; flesh soft, but no emaciation. Turpentine was prescribed in two-drop doses every two hours, and laudanum in one-and-a-half drop doses repeated sufficiently often to ensure quietude.

On the 29th the pulse was 152. At 1 P. M. she had a general convulsion, lasting about five minutes; in the evening she had an evacuation similar to those passed on the preceding day. The record for August 30th states: "Pulse 150 to 160; up to this time has been playful, but is now drowsy, and, when disturbed, fretful; manifests no desire for solid food, as before her sickness, but still nurses; has taken up to this time thirty-two drops of turpentine. When she cries or frets she has a spasmodic attack." This was the commencement of internal convulsions, with which this child was affected for several months. An opportunity was afforded of observing their character, for her excitement when she was examined was usually sufficient to produce them. After a succession of short expirations respiration ceased; for a moment she was apparently insensible; eyes closed; face pallid; no frothing at the mouth. The return of consciousness and respiration was without any laryngeal râle, and after the attack she seemed as well as before. No external convulsion and no evacuation of blood occurred after August 31st.

There was gradual improvement in her health, but she continued for many months pallid and irritable and subject to attacks of internal convulsions. On the 11th of April, 1859, when twenty-two months old, she had another attack of general convulsions. The record made on that day is: "Has had internal convulsions (one or more paroxysms) almost every day since last August, brought on usually by crying when she is corrected in any way or her wishes are refused." Again, on December 1, 1859, it is stated: "Has grown considerably since the last record, and appears to have recovered, except that at long intervals the spasms still occur." She took a preparation of iron, but her recovery seemed to be due more to the growth and development of the body and to hygienic than therapeutic measures.

The general health in internal convulsions is more or less impaired, except in mild forms of the disease, in which the convulsive attacks soon cease. Pallor or a sickly and cachectic aspect, irregular, usually constipated bowels, poor appetite, and moroseness or irritability of temper are common symptoms of severe and protracted cases.

Diagnosis.—This disease is easily diagnosticated, unless when its symptoms are masked by those of external convulsions; it may then escape notice. Spasm of the glottis may be mistaken for spasmodic laryngitis, and *vice versâ*. In some of the published cases this mistake appears to have been made. Spasmodic laryngitis is, however, so different not only in its nature, but in its clinical history, that a differential diagnosis is not difficult. It is an inflammatory disease, and is attended with feeble reaction and a sonorous cough; it commences at night after the first sleep and from exposure to cold—particulars in regard to which it contrasts with true spasm of the glottis, which in complicated cases is not attended by any febrile symptoms.

Prognosis; Modes of Death.—Statistics show great mortality in this disease. Dr. Reid, in a monograph on "Infantile Laryngismus," states that of 289 cases which he collated, 115 died. Rilliet and Barthez met with 1 favorable case in 9 unfavorable, and Herard 1 in 7. If the paroxysms be mild, infrequent, and dependent on a cause which can be easily removed, recovery is probable with proper treatment. The cause may, however, be such, even when the spasm is mild, that the case is necessarily unfavorable, as when it is due to disease of the cerebro-spinal axis. We should not, however, in any case consider the patient entirely safe, since grave symptoms may suddenly arise, so as to change entirely the prognosis. Long and severe paroxysms, with lividity of face and symptoms of suffocation, indicate an unfavorable result. The same should be predicted also if the infant gradually lose flesh and strength, especially if the face be pallid, the pulse feeble, and the appetite poor.

There are three modes of death in internal convulsions. The first is by

. The infant dies suffocated in the attack. Respiration is first arrested, en the pulse ceases, and at the autopsy the lungs and the cavities of eart are found engorged with dark blood. Death may also result from tate of the brain. In such cases passive congestion of the brain occurs obstruction to the return of blood from this organ to the heart and s; and if this congestion be not soon relieved serous effusion also occurs. h results from the congestion and consequent œdema or dropsy.

The third mode of death is from exhaustion. Repeated and severe attacks ermine the constitution; the infant gradually grows pallid and thin, and of inanition or of some disease which this state induces.

TREATMENT.—The treatment of internal convulsions has varied according he theories which physicians have held in reference to its cause. Gland-r enlargement is no longer regarded as a common cause, and therefore atment directed to its removal is less frequently prescribed than formerly. e causes of internal convulsions are in part very similar to those of eclamp-, and the remedies employed in the one affection are, in a measure, appro-iate in the other. That dentition is sometimes a cause is usually admitted, nd two cases, one of which occurred in my practice and the other was reported me, appeared to show that it may operate as a cause. The effect of entition is especially observed in weakly infants when several dental fol-icles are undergoing active evolution. Thus, in one of the cases to which I efer five teeth pierced the gums in the course of two weeks; after which no onvulsive attack occurred. If, therefore, the gums are swollen, the propriety of scarification should be considered, especially if the convulsions be so severe as to endanger life.

In all cases of internal convulsions a careful examination should be made in order to detect any aberration from the normal state which might cause nervous excitation. The condition of the digestive organs should be ascertained, and evacuants or other remedies prescribed if there be evidence of their derangement.

Sometimes the alimentation of the infant is at fault. It is perhaps bottle-fed and the stools have an unhealthy appearance. Attention should be given to the preparation of its food and the times of its feeding, or if it nurse the mother or wet-nurse who suckles it should have plain but nutritious diet, live with regularity, and give the breast to the infant at regular intervals. If there be a torpid state of the intestines, Dr. Meigs recommends "castor oil and aromatic syrup of rhubarb rubbed up together, three parts of the former and five of the latter." A simple enema answers well in such cases, and in debilitated infants this is preferable to medicine administered by the mouth. If diarrhœa be present, and it persist after the requisite changes are made in regard to the diet, remedies calculated to relieve it, which are mentioned elsewhere, should be employed. Marshall Hall states that he has ordinarily succeeded in curing the disease by attending to the condition of the gums and digestive organs.

Since rachitis is a not uncommon cause, the child should be examined in reference to rachitic manifestations, and if they appear the treatment appropriate for rachitis is required.

In pallid and cachectic infants tonics are indicated. The elixir of calisaya-bark with iron, in half-teaspoonful doses three or four times daily to an infant of two years, is an eligible preparation. The preparations of iron are frequently to be preferred to the vegetable tonics, as the citrate of iron and bismuth, citrate of iron and quinia, the syrup of iodide of iron, or the wine of iron. To an infant of one year the syrup may be given in doses of three drops, the citrates in one-grain doses, and the wine in doses of one teaspoonful, *every four hours*, or the liquor ferri peptonati may be employed.

Antispasmodics, as asafœtida, valerian, and oxide of zinc, are often prescribed in this malady, but they are less efficacious than the general tonic measures which I have mentioned. The salutary effect of bromide of potassium in eclampsia and epilepsy certainly justifies the trial of this agent in internal convulsions if they persist after the employment of invigorating remedies.

Hygienic measures are of the utmost importance. The infant should reside in dry and airy apartments, and should be kept much of the time through the day in the open air. Remarkable success sometimes attends this simple expedient when medicines have entirely failed. Mr. Robertson[1] of Manchester relates five severe cases in which this disease was cured by exposure of the infants several hours daily to a cool atmosphere. These cases were treated in the winter months, and were kept outdoor even during strong winds. Mr. Robertson has records of forty cases, all occurring between December and April, while he has seen no case in the summer months. As the result of such extensive experience the writer recommends "the free exposure of the infant out of doors for many hours daily to a dry, cold atmosphere, and, if the air be dry, the colder the better." Dr. Marshall Hall's experience was similar. Says he: "The curative influence of the air, and especially of the sea-breezes, is not less marked in this affection than in whooping cough." Mr. Robertson recommends also, as part of the tonic treatment, "free sponging of the body every morning with cold water." In February, 1867, I attended a nursing infant five months old with internal convulsions, the paroxysms being attended with lividity of the face and at times tonic convulsions of the limbs. Among the remedies employed was bromide of potassium, but more benefit obviously accrued from keeping the infant much of the time in the open air than from the medicines employed. The disease passed off in six or eight weeks.

Unless the cause be of such nature that it cannot be removed, the above hygienic and therapeutic measures will, in a large proportion of cases, be followed by a satisfactory result.

The mother or nurse may abridge the paroxysm by raising the infant, blowing upon it, sprinkling water in the face, or gently stroking it. Dr. Hall recommends tickling the nostrils with a feather to produce respiration, or the fauces to occasion vomiting, and thereby interrupt the paroxysm. Anything which causes a sudden and profound effect upon the system may abridge the attack. This was effected in one case in the practice of Dr. C. C. Meigs by applying a cloth wrapped around ice over the epigastrium and the lower part of the sternum. The chief danger during the attack is from congestion of the brain, with effusion of serum or extravasation of blood. If the attack be severe and the features congested, so that there is evident danger of such a result, cold applications should be made to the head, derivatives applied to the extremities—as sinapisms or mustard foot-baths—and the bowels should be speedily opened by enemata.

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[1] *London Med. Gazette*, Jan. 14, 1865.

CHAPTER XIII.

TETANY.

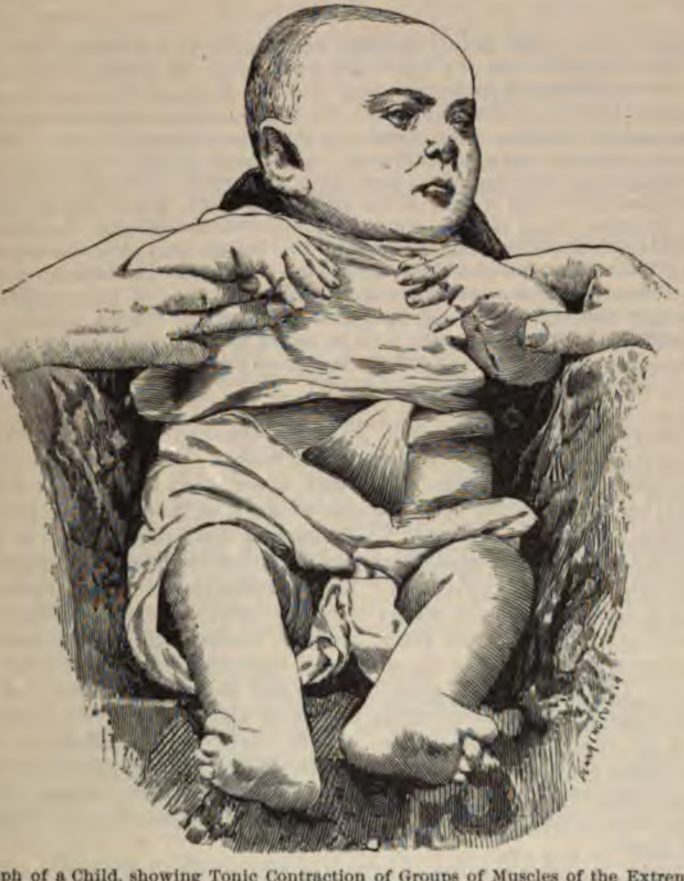
THE disease known as tetany has probably always existed, for its recognized causes are of common occurrence, but the attention of the profession was first directed to it by a memoir bearing the title "Observations sur une Espèce de Tétanos intermittent," published by M. Dance in the *Archives générales de Médecine* in 1831. He described it as it occurs in the adult. In the following year (1832) M. Tonnelé published in the *Gazette médicale* an essay on tetany, which he designated a new convulsive disease of childhood. In the same year Constant and Murdoch also published their observations on this malady in French medical journals, the former designating it "contractures essentielles," and the latter "retractions musculaires et spasmodiques." In 1835 the memoir of De la Berge on tetany, bearing the title "retractions musculaires de courte durée," was published in the *Journal Hebdomadaire*. From this time the disease was fully recognized in France, and several additional monographs relating to it appeared in medical journals prior to 1850, among the most notable of which was the thesis of Delpech in 1846. The term tetany (tétanie) was first employed by Dr. Lucien Corvisart in an interesting and instructive paper published in 1851.

The term tetany is applied to a disease which is characterized by tonic contraction of muscles, commonly those of the extremities, but sometimes also those of the face or trunk, produced by causes external to the nervous system, and usually of temporary duration. The exception to this definition might be as regards such causes as are psychical or emotional, if such exist. Following this definition, we would exclude cases of tonic muscular contraction, however close the resemblance, which arise from disease of the brain, spinal cord, or their meninges, or from disease of the nerve supplying the affected muscle. The contractions in these cases are not the malady itself, as in tetany, but are merely symptoms of some important disease located in the nervous system at a distance from the affected muscles.

CAUSES.—Tetany may occur at any age, but is most frequent in infancy, in early childhood, and in early adult life. Of 28 cases observed by Rilliet and Barthez, 1 was at the age of nine months, 13 between the ages of one and two years, 5 at the age of three years, and the remaining 9 between the ages of three and fifteen years. Eustace Smith says that the period during which the largest number of cases occur is between the first and third years. In 142 cases collated by Gowers the ages were as follows: Between one and four years, 34; between four and nine years, 8; between nine and nineteen years, 36; between nineteen and twenty-nine years, 24; between twenty-nine and thirty-nine years, 23; between thirty-nine and forty-nine years, 13; and between forty-nine and sixty-one years, 4. Erb remarks that a strong tendency to tetany is exhibited in early childhood, and the next most common period of its occurrence is at the age of puberty and early youth. The statistics of different observers show that tetany is more common in males than females. Of Rilliet and Barthez's 28 cases, 20 were boys. Of the 142 cases embraced in the statistics of Gowers, 76 were males and 66 females. According to Gowers, in the first and second decades, in which a large majority of the cases occur, more males are affected than females, but between the ages of twenty and fifty years females proponderate, while above the age of fifty years all the recorded cases have been males. It is seldom that the most thorough investigation elicits any inherited predisposition in cases of tetany to nervous or other diseases. Most of the observed cases have occurred singly in families, and in families which exhibit no special tendency to nervous or other ailments. Rarely, however, multiple cases have occurred in families, from which we infer that there may be an inherited neuropathic tendency. The only instances of this sort which I have been able to find in the literature of tetany were 2 cases observed by Murdoch in one family, and cases alluded to by Abercrombie, who states that at different times 4 cases occurred in each of two families, and 2 cases in another family.

Although in many instances different causes appear to act simultaneously in causing tetany, nearly all writers who have contributed to the literature of this malady assign the most important place in the causation to diseases of the digestive apparatus. Trousseau states that in the cases which have fallen under his observation diarrhœa has been commonly present. He says that in 1854 he met many cases following cholera, but in one instance occurring in his practice the cause seemed to be obstinate constipation. The patient at the age of seventeen years was suddenly seized when travelling. His fingers were bent and he could not extend or use them. The tetany subsided in two or three hours, but it recurred every day for three months. He was treated by bleedings, but the tetany was uniformly worse after each loss of blood, the contractions becoming more severe and also more general. Not only were the muscles of the extremities in a state of tetanic contraction, but also those of the face and trunk, so that respiration and speech were embarrassed. Although the contractions were aggravated by bleeding, and were never so bad as after the fourth venesection, they ceased entirely for a period of ten months after cupping along the spine. Subsequently they recurred every year at the close of winter and continued two months. The patient was habitually constipated, and the torpid state of the bowels seemed to be the chief factor in producing the tetany. In the following case, which I have recently had under observation, constipation appears also to have been the chief cause: George C——, without teeth and at the age of seven months when tetany commenced, was taken from the breast at the age of two months. He lives in a tenement-house, and from the time of weaning has been fed with condensed milk, one heaped teaspoonful of large size to fifty of water. Besides this, he has taken once daily a tablespoonful of Nestlé's food in ten of water. With this diet his growth has been about like the average, but he has been habitually very constipated, so as frequently to require assistance in obtaining an evacuation. Recently, groups of muscles in all the extremities have undergone tonic contraction, producing deformities, as shown in the photograph (Fig. 37), and brief attacks of laryngismus stridulus. These attacks of spasm of the glottis occur both by day and by night, causing for a moment the characteristic stridulous respiration. The mother states that at times he is feverish, probably from the constipation, but usually he seems entirely well, except as regards the sluggish state of the bowels and the contractions. Attempts to straighten the fingers and toes elicit cries from the pain. The mother also says that at times both thighs and both legs are flexed, and he resists attempts to straighten them on account of the pain. The treatment employed consisted in the use of bromide of potassium and measures designed to relieve the constipation. When these remedies were perseveringly employed, the contractions gradually diminished and ceased, but they returned when the treatment was discontinued. Four months have elapsed since the commencement of the disease, and it is only in the last week or two that the contractions have entirely ceased. The [illegible] factor in producing the tetany in this case appears to have been the habitual constipation. One tooth pierced the gum during the four months of tetany.

FIG. 37.



Photograph of a Child, showing Tonic Contraction of Groups of Muscles of the Extremities as the Result of Tetany.

Erb says that all forms of intestinal disease may cause tetany, but it especially occurs after "protracted and exhausting diarrhœa." Gowers also remarks that the most common cause of tetany is diarrhœa, "usually long-continued and exhausting, but sometimes acute and brief." Among the rarer intestinal causes of tetany may be mentioned the presence of worms. I have not found in the literature of tetany any instance in which lumbrici or ascarides caused the contractions, but Gowers alludes to three cases in which they were produced by the tape-worm.

From the nature of tetany, and from the important part long assigned to dentition in producing nervous ailments, it is perhaps remarkable that the teething process has so seldom been regarded as a factor in causing tetany in young children. But, so far as I have been able to learn from memoirs and recorded cases, those who have made special study of tetany agree for the most part with Trousseau, who says that in nearly all instances pathological conditions distinct from dentition are present, "on which tetany would seem rather to depend." Nevertheless, in the following case which was treated by Professor E. G. Janeway and myself, after repeated and thorough examinations teething was regarded by both of us as the chief cause of the contractions:

Case.—B——, aged twenty months, well-nourished, has during the last few days been unable to use the left lower extremity. The thigh is flexed at an angle of about forty-five degrees, and the leg at about the same angle, and attempts to overcome the rigidity of the flexors and straighten the limb are resisted and are painful. The muscles in the other extremities, and those which move the foot and toes of the affected limb, appear to have their normal functional activity, as do those of the face, neck, and trunk. The gums were swollen and congested over the crowns of five advancing teeth, which appeared to be in nearly the same stage of development, and were evidently soon to protrude. It is possible that a rather sluggish state of the bowels may have been a factor in causing the tetany, but the chief agent was apparently the cutting of so many teeth. There was not at any time any notable elevation of temperature, loss of appetite, or derangement of the functions of important organs, but the contractions continued three weeks, when all or nearly all the imprisoned teeth escaped and the limb was quickly restored to its normal state. There has been after the lapse of two years no return of the tetany.

Tetany is more liable to occur in those whose systems are enervated by pre-existing disease than in those who are robust. Rilliet and Barthez state that in cases which have come under their observation the patients were often in poor health, resulting from disease which they had had, as pneumonia, bronchitis, or enteritis. Bouchut also remarks that tetany occurs as a sequel of various enervating maladies, among which he enumerates cholera, typhus and typhoid fevers, and dysentery. Erb mentions the following diseases which sustain a causal relation to tetany or in the convalescence from which tetany is liable to occur: typhoid fever, measles, cholera, Bright's disease, febris intermittens, in addition to the diarrhœal maladies which have been alluded to above. Eustace Smith goes farther, and states that tetany is rare in robust subjects—that it ordinarily occurs in those who have delicate constitutions by inheritance or disease or are imperfectly nourished. Gowers, enumerating the maladies which are followed by tetany, mentions "typhoid fever, cholera, smallpox, rheumatic fever, measles, febricula, catarrh, and pneumonia;" and he states also that in young children the indications of rachitis are rarely absent.

Another recognized cause of tetany is taking cold. Exposure to wet and cold has in numerous instances been followed by tetany. From this mode of origin the opinion arose that tetany is a rheumatic affection. Hence, Eisenmann applied to it the term brachiotonus rheumaticus, and Benedict designated it rheumatische contractur. Erb says: "Amongst the exciting causes, catching cold is both the most important and the most common; and this statement," he adds, "is supported by the fact that many physicians have regarded it as an exquisite example of rheumatic disease. Working in the wet or cold or in water, sleeping on the damp ground, have very often been regarded as causes, and the swelling in the joints which occurs in many instances indicates that this disease has a somewhat close relation to true rheumatism." It must be recollected that Erb's observations have been chiefly with adults. As regards infancy and early childhood, other causes of tetany are apparently more common than taking cold. Adults with tetany often attribute the attack to exposure in wet and inclement weather, and probably correctly. At the present time, in Charity Hospital, a female aged [illegible] years is under treatment for tetany. She said that her sickness was produced by exposure in wet and cold weather. She was employed as a seamstress, and, being insufficiently clothed, sat at her work with feet chilled and wet. At the same time her menstruation had been irregular, and she had diarrhœa, apparently produced by the exposure. Tonic contractions occurred in the muscles of the fingers and toes on both sides, accompanied by pain, especially in the affected muscles of the lower extremities. Several months have elapsed since the commencement of the disease, and the fingers have regained nearly or quite their normal state, but the toes are firmly flexed. The chief cause of the tetany in this case appeared to be taking cold, from which probably the diarrhœa resulted, which, as we have seen, is one of the most common causes of the tonic contractions. Trousseau also relates cases in which exposure to cold was apparently the exciting cause. Gowers also states that next to diarrhœa the most common causes are "exposure to cold, acute disease, and lactation."

Among the other recognized causes of tetany we may mention suckling, pregnancy, and the development at the time of commencing puberty. The first cases seen by Trousseau in Necker Hospital occurred in women recently confined who were wet-nursing, so that at first he designated the disease *rheumatic contraction occurring in nurses*. Gowers says that the frequency of the disease in adult women is chiefly due to maternity. The following are occasional causes mentioned by various writers: anæmia, prolonged muscular effort, alcoholism, onanism (Gowers), ergotism, violent excitement (Erb), irritation of uric-acid calculi (Eustace Smith).

From the nature of tetany it would seem probable that it might occasionally result from preputial irritation, but I have not been able to find the history of any case in which this cause was assigned, either in the literature of tetany or in monographs relating to a narrow, irritated, or inflamed prepuce. Tetany does not result, or very rarely results, from burns or ordinary wounds; but Weiss in 1883 reported 13 cases in which it occurred from excision of the thyroid, and, according to Wölfler, in 70 cases of this operation tetany resulted 7 times.

It is remarkable that this disease appears to occur as an epidemic—a fact not easy of explanation, unless upon the supposition that the rheumatismal cause due to atmospheric conditions, or the psychical or emotional cause giving rise to imitation, is operative at the time. Bouchut says that tetany occurred as an epidemic in Germany in 1717, in Belgium in 1846, and in Paris in 1855. In the Paris epidemic it occurred equally among children and adults, and was the occasion of interesting observations by Aran and Barthez. Another epidemic occurred in Paris in 1876 and in its environs, especially at Gentilly, where in a school the teacher and thirty pupils were affected; but some of the pupils afterward confessed that they had feigned the disease. In New York City, in the first quarter of 1889, I saw so many cases that it seemed to me that tetany might properly be regarded as an epidemic.

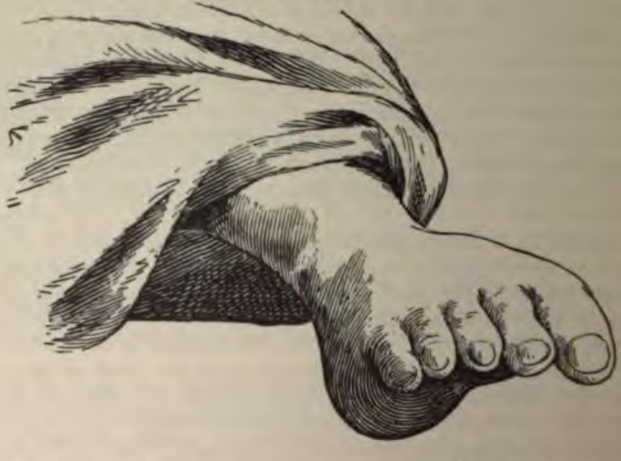
SYMPTOMS.—Ordinarily, tetany occurs without any marked premonitory symptoms, but in some instances it is preceded by pain in the head or spine, vomiting without any previous indigestion or gastric derangement, and a general feeling of indisposition. Usually, in those old enough to express their sensations, tetany begins with tingling, burning, or other unusual sensory manifestations in the limbs. The tonic contractions occur suddenly, sometimes in the upper and lower extremities simultaneously. Rarely, the contractions occur in the upper extremities alone or in the muscles of the trunk. At first a feeling of stiffness is experienced, and this is followed by tonic contractions, with the fixing of the affected part in a state of persistent flexion or extension. Usually, as regards the upper extremities, the contraction of the thenar and hypothenar muscles causes hollowness of the palms of the hands; the first phalanges of the fingers are flexed, the second and third phalanges extended, and the thumb adducted and flexed so as to press against the index finger or lie underneath it. The fingers sometimes incline toward the ulnar side, and sometimes are pressed against each other. Usually the hand is slightly flexed, as is also the forearm. The muscles which move the arm usually escape, but exceptionally there is adduction of the arm on the shoulder. The hand may be extended instead of flexed, and all the joints of the fingers extended, or they may all be flexed and the fist closed.

The thighs may be adducted or flexed, the legs extended or flexed, the foot extended, forming a talipes equinus, and the toes flexed, as in the following interesting case now in Charity Hospital, which has been alluded to above. Though the patient is an adult, her case is related here, since it aids in throwing light on the nature of the disease:

CASE.—Mary F. O——, native of the United States, seamstress, married, and of apparently healthy parentage, states that her health was good previously to the present sickness. She says that she has never had venereal disease and never taken stimulants in excess, though in the habit of using whiskey at breakfast. She had been married four years, and three years ago had a stillborn child at the seventh month, but has had no other miscarriage and has had no confinement at term. Her catamenia, which formerly were scanty and at unusually long intervals, have during the last four months been normal in regard to time and quantity. She has been subject to afternoon headaches for years. She has had the average appetite, has partaken largely of rye bread at her meals, and her stools have been normal.

In January, 1888, the patient, being employed as a seamstress in a shop at a distance from her residence, began to experience unusual fatigue, and on returning from her day's work she frequently noticed a painful burning sensation in her feet, the pain extending upward along the calves of her legs. This pain in the feet and legs gradually increased until March 12, 1888, at the time of the deep snow accompanying the "blizzard." After walking through the snow she sat all day at her work with wet feet, and at this time she began to experience a dull intermittent pain extending from both ankles to the knees, and accompanied by great lassitude, so that walking required an effort. In July the pain became more constant, but at the time of her admission into Charity Hospital (August

FIG. 38.



17th) it was not so constant or severe. Soon after her admission the feet became strongly extended, forming a talipes equinus, and the toes of both feet were also strongly flexed. Sensation in the toes, but not in the feet, was almost completely lost. A few days subsequently the fingers on both sides were similarly flexed, but without pain or loss of sensation. In about six months the flexion of the fingers ceased, and she can now use them nearly as well as before the attack. The toes also are not so strongly flexed as at first, and they have regained sensation. The bladder has never been affected, but the sphincter ani was paralyzed for a time in August, so that the feces escaped involuntarily in bed. The patient's memory was considerably impaired after the exposure at the time of the "blizzard," but is now (June, 1889) apparently nearly or quite normal. Otherwise no impairment of the mental faculties has been observed.

The tetany in this case has been, as usual, bilateral and for the most part equal on the two sides, with a little more acuteness of sensation in the right than left limbs. The feet continue in the position of talipes equinus, with toes flexed, and the contracted muscles hard to the feel, almost like cartilage. No œdema has been observed, but perspiration occurs from the extremities during sleep.

In mild cases or those of ordinary severity the contractions are limited to the muscles of the extremities, and are more marked and persistent in those that move the hands, feet, fingers, and toes than in other muscles; but in severe cases the muscles of the trunk and head participate. Contraction of the abdominal muscles produces rigidity of the abdominal walls. Spasm of certain of the thoracic muscles occasionally occurs, causing dyspnœa and even lividity. In some of these cases of embarrassed respiration the diaphragm is probably involved. Opisthotonos, retention of urine, anteflexion of the neck from contraction of the sterno-mastoids, fixation of the jaws from spasm of the masseters, retraction of the angles of the mouth, stiffness of the tongue, and indistinct articulation are occasional symptoms in severe cases of tetany.

The contractions render the affected muscles hard and unyielding, and the child cries from pain when attempts are made to straighten the limb. If the spasm be slight some voluntary movement of the affected muscles is possible, but it is restrained and difficult. In severe cases, with the muscles tense and unyielding, voluntary motion is impossible. Except in the mildest forms of the disease pain is felt in the contracted muscles, such as all people experience when a spasm occurs in the calf of the leg, and the pain may pass upward along the limb. The pain may occur in paroxysms with distinct intermissions, or, without ceasing, it may vary in severity at different times, probably from some variation in the degree of spasm. Certain subjective symptoms, such as numbness and tingling, which sometimes occur in tetany, may continue during the intermissions or remissions. After some hours or days the rigidly-contracted muscles relax and the disease disappears, except perhaps that a degree of stiffness remains. But the respite is usually not long. The spasms recur, and several successive recurrences and intermissions take place, running over months, before the disease is permanently cured. During the intervals in the contractions the affected nerves and muscles are in ordinary cases unduly excitable, so that sudden pressure or percussion causes some contraction. Trousseau was perhaps the first who noticed and called attention to the fact that compression of the artery and nerve supplying the contracted muscles in tetany causes or increases the contraction. Occasionally this result cannot be obtained.

It is an interesting fact that in cases which I have observed the spasms do not cease in sleep, though the contraction of the muscles may not be as great as when the patient is awake.

The electrical excitability of the nerve which supplies the contracted muscles is increased. Gowers states that he has obtained contractions in the muscles of the face by the voltaic current from a single cell. The increased excitability of the nerves is apparent if either the direct or induced current be used. According to Erb, when the circuit is closed the earliest contractions occur at the point of application of the positive pole. Both opening and closing the circuit cause a more prolonged contraction of the muscles in tetany than in health. When the contractions are strong, œdema sometimes occurs, especially upon the dorsal surfaces of the hands. It was present in cases treated by Henoch, who attributes it to compression and consequent passive congestion of the veins, produced by contraction of the interossei muscles, the congestion giving rise to serous transudation. When the paroxysms are severe, perspiration sometimes occurs, and an erythematous redness may appear over the affected muscles. Occasionally in acute attacks the temperature is moderately increased, but ordinarily it is normal. Tetany does not usually affect the functions of the internal organs, but in a case related by Kussmaul and another by Nönchen albuminuria was for a brief period present, and in one recorded instance the urine exhibited traces of sugar during the paroxysms. Occasionally in long-continued tetany the contracted muscles undergo a degree of atrophy which is attended by diminished electrical irritability. Gowers states that "general muscular atrophy" has also been observed following tetany.

The following may be regarded as typical cases of tetany in infancy as I have observed it in New York. The following case occurred in the New York Infant Asylum during my term of service, and the resident physician, Dr. Virginia M. Davis, has kindly furnished me the history from her notebook:

CASE I.—Gertrude A——, born in the New York Infant Asylum, April 30, 1888, was well except a mild attack of pertussis until March 9, 1889, when she had a prostrated appearance, and the thermometer indicated a temperature of 105°, and a little later 105.5°. During the following six hours she had five large, watery, but yellow stools. She was restless, her features sunken, extremities cool, her surface covered with a clammy perspiration, and her pulse feeble. Her diarrhœa was checked, and she slept during the following night. From March 9th to 14th she had slight fever (100.4°–100.6°) and her stools were normal, but during the week ending with the 14th she lost one pound in weight. The following are the subsequent notes of the case:

March 14th.—Is restless; temperature in the morning 100.4°, in the evening 103°; has had no stool in the last twenty-four hours. To-day has had for the first time contraction of the flexor muscles of the hands, feet, fingers, and toes, so that in the evening all the fingers and toes are firmly flexed. The dorsal surfaces of the hands and feet, and the fingers and toes as far as the articulations of the first and second phalanges, are œdematous. The flexions can be overcome by the employment of considerable force, but the attempt is painful. An erythematous eruption has appeared over the upper part of the chest and upon the back.

March 15th.—Temperature 100.6°; thumbs extended, voluntary movement of fingers returning; toes still flexed; œdema as before; rash fading; stools normal. March 16th. Temperature 99°–99.8°. The contractures have entirely disappeared during the day. Had four stools. 17th. Bowels constipated; slight contractures of the fingers. 18th. Morning temperature 103°; evening, 101°. In the evening contractures of both extremities disappearing; stools normal; gums swollen. From this time the constipation was relieved by small doses of calomel, and the tetany ceased. Some elevation of temperature was a prominent symptom previous to and during the tetany, and on one day (May 17th) an attack of general clonic convulsions or eclampsia occurred. The tetany ceased on the 18th or 19th, but between the 20th and 30th maculæ and papules appeared on the surface, due perhaps partly to the medicines employed, which were chiefly the bromides and chloral.

CASE II.—Edward McI——, aged fifteen months (practice of Dr. Vineberg, but examined by myself), has healthy parentage, and no other child in family has had any nervous ailment, except a single attack of eclampsia during measles in one of the children. Edward is nourished in part at the breast and in part from the table. He has four teeth, all having cut the gum since the age of twelve months. He has had diarrhœa much of the time since birth, and during the last two months has had free perspiration from the head. The mother states that during the first months of his life he occasionally held his breath, especially at night, but with this exception no symptoms resembling a convulsive attack were observed until recently, when, during an attack of coughing, his face grew red, his eyes turned upward, and his respiration ceased for a moment. When he was at the age of twelve months the mother first noticed that the toes were flexed and the feet extended as in talipes equinus. Considerable force was required to overcome the tonic contraction of the affected muscles, and when the pressure was relaxed the feet immediately assumed the former position of talipes. The thumbs were strongly flexed across the palms of the hands, the index and middle fingers forcibly extended and separated from each other, and the ring and little fingers were flexed against the palm. These abnormal flexions and extensions continued more than three months, with occasional intervals of two or three days, during which the action of the affected muscles was nearly normal. The child presents evidences of rachitis in the shape of its head and enlargement of the epiphyses of the extremities.

The treatment employed by Dr. Vineberg consisted in change of diet and in the use of the following prescription:

℞. Zinci sulphat., gr. $\frac{1}{4}$;
Atropiæ sulphat., gr. $\frac{1}{192}$. Misce.

To be taken three times daily.

With this treatment the spasms of the muscles entirely disappeared within a week, and two weeks later had not returned.

It is our purpose to treat mainly of tetany as it occurs in children, but in order to give completeness to our remarks on this disease it is necessary also to describe it as it occurs in the adult. The following case, related by Trousseau, gives a clear and vivid idea of the symptoms of severe tetany as it occurs in the adult. A dissipated young man was found one morning lying in the street, "stiff as a poker" from the occurrence of tetany during the night. He was conscious and complained of great pain, but spoke indistinctly from the clenched state of his jaws. Muscles in his extremities were rigidly contracted, and, being unable to walk, he had fallen down and could not rise. The rigidity of the muscles of the chest and abdomen, and probably of the diaphragm, rendered respiration difficult. His face was livid, and he had paroxysms of dyspnœa that threatened suffocation. The tetany finally abated, and he was able to walk and attend to slight duties, but at intervals he had recurrence of the spasms, and finally died of phthisis.

Adults, unlike young children, give a clear description of their subjective symptoms. Frequently—probably in a majority of instances in the adult, as in the child—tetany is preceded by certain sensory symptoms, as formication, a sensation of weight or dragging, of heat or cold, or even of pain. Soon afterward in using the limbs the patient observes some stiffness or that the movements are not so free and easy as previously. The spasms succeed, and, as in children, their duration and severity vary greatly in different patients. In the adult, as in the child, in mild tetany the contractions are limited to the muscles of the hands, feet, fingers, and toes, and the severe disease usually attacks first these muscles, and afterward extends to the muscles of the head, face, neck, and trunk. Cases might be cited from the literature of tetany in which the contractions occurred in the muscles of the face, causing unsightly visage, the motor muscles of the eye, causing strabismus, the pharyngeal and laryngeal muscles, the muscles of the tongue and diaphragm, causing embarrassment of speech, respiration, and deglutition, sterno-cleido and other muscles of the neck, changing the position of the head; and in the various muscles of the trunk. In a case observed by Dr. Herard the recti muscles in the abdominal walls stood out like two tense cords. However severe the disease may be, a marked remission or distinct intermission soon occurs, the progress of tetany being characterized by intervals of complete relief. In not a few of the reported adult cases tetany has reappeared at varying intervals during a series of years, being due to the recurrence of the causes which first produced it.

PATHOLOGY.—Since tetany in itself is rarely fatal, only a few post-mortem examinations have been made, and in these no lesions have been discovered which appeared to sustain a causal relation to the disease. In the spinal cord minute hemorrhages, points of apparent myelitis, lymphoid cells, hyperæmia of the spinal meninges and of the cord in their upper portions (Bouchut), and softening of the cord in the cervical region, have been observed in certain cases, but these lesions are believed to result from the excessive functional activity of the cord. The exaggerated excitation of the motor nerves is probably also attended by some change in their nutrition. Gowers says that change in their nutrition consequent on their excited action is undoubtedly present. He states that a nutritive change in the motor nerve-fibres is usually consequent on, and secondary to, a similar change in the motor cells of the spinal cord, the axis-cylinders of the nerves being prolonged processes of these cells. Slight changes have been observed in these cells in those who have had tetany severely, and the fact that this disease is bilateral indicates that it has a central origin. Gowers adds that the sensory nerves are also probably implicated, from the fact that sensory symptoms often precede the spasms of tetany. As to the seat of the disease, nothing further is at present known; but Gowers, after a careful survey of the facts relating to the pathology of tetany, remarks: "On the whole, our present knowledge of the pathology of the disease points to the nerve-cells of the spinal cord and medulla as the parts chiefly deranged, and the way in which the cells in rare cases seem to undergo subsequent atrophy suggests that the disturbance is a primary one of the cells themselves, and is not produced by the agency of any vaso-motor mechanism. It is difficult to conceive that symptoms of such definite and uniform character can be the result of any vascular spasm. The occasional wasting, with diminished irritability, is especially important as suggesting that the nutritional changes in the motor-cells and fibres, causing the increased excitability, may sometimes go on to structural degeneration."

DIAGNOSIS.—It may assist in the diagnosis to ascertain that the attack has immediately followed the occurrence of one of the recognized causes of tetany, as diarrhœa or other intestinal ailment or exposure to cold. We may diagnosticate tetany from tetanus from the fact that it is very rare under the age of one month, if indeed it ever occur in the newly-born, whereas tetanus almost never occurs in infancy after the first month or in childhood, nearly all cases occurring during the first three weeks after birth. It is also distinguished from tetanus by the fact that it begins in the extremities, has periods of cessation or intermittence, and the masseters, which in tetanus early undergo the peculiar tonic contraction, are not affected or are affected only at a late stage and in the most severe cases.

In organic disease of the brain the contractions do not, as a rule, intermit, and they are frequently limited to one side; besides, other symptoms clearly referable to the brain are usually present. The bilateral and symmetrical nature of tetany, the occurrence of the contractions in corresponding groups of muscles on the two sides, distinguish the disease from those contractions which occur from lesions in the course of the nerves.

Prognosis.—Tetany, whether intermittent, remittent, or occurring with little variation in the spasms, soon ceases in some cases and never returns. In other instances it does not cease entirely for months, though varying in severity at different times. Certain patients have attacks of it at intervals during a series of years, their health being good when not affected by it. Thus the case of a woman is related whose first attack was at the age of twenty-two years, and who had a recurrence of the disease every winter, and was still having it at the age of thirty-four years. This appears to have been one of those cases which have been attributed to a rheumatismal cause incident to cold weather. Lussana relates a similar case in which tetany occurred each winter during ten successive years. In some instances years elapse between the attacks, as in a case related by Choostek. Maccall states that a woman had tetany five times when wet-nursing five successive children, and was well in the intervals.

During infancy and childhood tetany, when uncomplicated, ends favorably, with possibly now and then a rare exception. In this respect it contrasts with tetanus, which, whatever the age, is, with few exceptions, fatal. The few cases found in the literature of this disease in which death apparently resulted directly from tetany have been, so far as I have been able to ascertain, adults. Dr. Blondean states that in Lourcine Hospital, Paris, a young woman whose health had been greatly impaired by syphilis and a miscarriage had an obstinate diarrhœa. Tetany set in with great violence. The muscles of the face, neck, and chest were rigidly contracted. The face was livid, the eyes fixed, the pulse could not be counted, and the breathing was labored and stertorous. She was bled from the arm, and subsequently twelve leeches were ordered to be applied behind the ears, but during their application she died. The post-mortem examination, conducted with great care, revealed an apparently healthy state of all the organs except "traces of congestion in the meninges, the veins of which contained a little more dark blood than usual." Gowers states that death may occur in consequence of pulmonary congestions and a low form of pneumonia which result from repeated attacks of tetany. Tetany following excision of the thyroid is more likely to be fatal than when it occurs from other causes. But, we repeat, so rarely is tetany fatal that most of those who have contributed to the literature of this disease have never observed a fatal case. Muscular weakness for a time, and even more or less muscular atrophy, occasionally follow an attack of tetany.

Treatment.—The cause or causes of the attack, so far as they can be ascertained, should obviously be promptly treated, and if possible removed. Especially should diarrhœa or any other abnormal state of the digestive system receive appropriate treatment. If the patient have been exposed to cold, and the cause be apparently of a rheumatismal nature, warm baths and diaphoretics, such as are employed in breaking up a cold, may be advantageously employed.

In the treatment of the tetany of children the bromide of potassium is a most useful remedy. Four grains dissolved in cold water or any convenient vehicle may be given every third or fourth hour to a child of from one and a half to two years. It is a safe remedy, and it usually causes a diminution or cessation of the spasms. Cannabis Indica, chloral, and hypodermic injections of morphia which have been employed in adult cases with apparent benefit should not be recommended for young children. It will be recollected that in the case treated by Dr. Vineberg, related in a preceding page, the infant at the age of fifteen months took one-quarter of a grain of sulphate of zinc and $\frac{1}{192}$ of a grain of sulphate of atropia three times daily, and with this treatment and a change of diet recovered within a week. Chloroform inhalation has been used, and during the narcosis produced by it active massage treatment of the affected limbs has been employed with apparent benefit. Gowers states that faradism is contraindicated, and that the best results have been obtained from the voltaic current, either with both poles applied to the spine or with the negative pole to the spine and the positive over the affected muscles. But the treatment by electricity, by chloroform, and, we may add, by ice over the spine, as practised by Trousseau, is more applicable to adult cases than to children.

A large proportion of children having tetany exhibit rachitic symptoms, and when such symptoms are present cod-liver oil and iron should be prescribed, and at the same time that the bromide of potassium and other remedies designed to relieve the tetany are employed.

CHAPTER XIV.

CHOREA.

Chorea, or St. Vitus's or St. Guy's dance, is a neurosis which is characterized by irregular and involuntary muscular movements, without loss of consciousness. The movements occur in the muscles of volition, and there is probably no one of them that may not be engaged, though some are more frequently affected than others. It is not known that any involuntary muscle is ever involved, though Sir William Jenner has expressed the opinion that occasionally the papillary muscles of the heart are, so that by their spasmodic contractions they produce insufficiency of the mitral valve. This, according to him, affords explanation of the fact that in certain instances a mitral regurgitant murmur is heard, which disappears about the time that the external movements cease. It is rare, however, that a mitral regurgitant murmur, heard during chorea, ceases when the latter terminates, and it is not improbable that in such cases there is, after all, a lesion of the valve, due to recent endocarditis, whether of a rheumatic or other origin; for a valve may be so thickened by recent inflammation as to cause a murmur, and after a few weeks or months the infiltrating substance be so absorbed that the murmur is no longer audible. If we admit the fact that cardiac bruits occasionally appear and disappear with chorea, this explanation seems to me more plausible than that of Jenner. Hillier says in reference to this subject: "My own experience leads me to doubt the existence of dynamic apex murmurs in chorea; that is to say, murmurs produced in hearts entirely free from organic change. If such murmurs ever occur, they are certainly rare. Organic murmurs of the heart, on the other hand, are common in chorea, and I am inclined to believe that organic disease of the heart often exists in chorea when there is no murmur." We shall see, by a case presently to be related, that this opinion is correct. Hillier also calls attention to the fact that choreic movements are irregular; but a cardiac bruit occurring regularly and uniformly, if not due to organic disease, would require rhythmical contractions of the papillary muscles to produce it. We infer from this that the bruit does not have a choreic origin.

In the class of children's diseases in the Bureau for the Relief the Outdoor Poor in New York City, 16,986 children were treated in the two years and three months ending with March 31, 1877. Of these cases 82, or 1 in every 207, had chorea. The patients were all under the age of fifteen years. Statistics published by observers in Europe show that the relative frequency of this disease is probably about the same in the large European cities as in New York. Thus, according to Hillier, amongst 122,621 out-patients treated at the Hospital for Sick Children in London, 406, or 1 in 322, had chorea, while of the in-patients, 174 in 5585, or 1 in every 32, were choreic. In the Parisian Hospital for Sick Children, of 84,968 admitted in twenty-one years, 531 had chorea, or 1 in every 161.

AGE.—Chorea may occur at any period of life, but a large majority of the cases are in childhood. It is rare in infancy and it rarely begins after puberty. Under the age of five years the propartionate number diminishes as we approach the time of birth. The youngest in the statistics of Hillier was three months. In 1870, in the Bureau for the Out-door Poor a child was presented for treatment who, the mother said, had had chorea from birth, and in 1877, I treated a young woman with severe general chorea who, repeatedly questioned, uniformly said that she had had the disease, without any assignable cause, from the first week of her life, and her friends corroborated the statement. The following table exhibits the relative frequency of chorea at different ages:

	6 years and under.	6 to 10 years.	10 to 15 years.
Children's Hospital, London, Hillier, none over 12 years admitted	81	237	104
M. Rufz	10	61	118
Bureau for Out-door Poor (prior to 1875)	2	26	16

	At and under 3 years.	3 to 5 years.	5 to 10 years.	10 to 15 years.
Bureau for Out-door Poor (since January 1, 1875)	5	30	337	130

M. Sée collected the statistics of 531 cases occurring in the Children's Hospital, Paris, and from them concludes that the maximum frequency of chorea is between the sixth and tenth years. Only 28 of his cases were under six years, the remainder, 503, occurring between the sixth year and puberty.

CAUSES.—The profession are nearly agreed in regard to certain causes of chorea, while there is a diversity of opinion in reference to others. It is admitted that in a large proportion of cases there is a neuropathic state which antedates and predisposes to chorea. This state is often manifested in the family history by a proneness to affections of the nervous system, and in the individual by a highly excitable state of the emotions, so that he evinces joy, grief, or anger from slight causes.

All writers admit that there is often an inherited predisposition to chorea. In 27 of 48 cases, Radcliffe found that father, mother, brother, or sister had been or was the subject of one or other of the following disorders: paralysis, epilepsy, apoplexy, hysteria, or insanity. The children of parents who when young had chorea or who exhibit proneness to ailments of the nervous system are more liable to chorea than other children. Hence the fact, sometimes observed, of different children in the same family becoming affected with chorea when they attain the age at which this disease ordinarily occurs. In one family in my practice three girls at different times were affected.

Sex.—The emotions are strong in girls, since in them the nervous system predominates, while the muscular power is weaker than in boys. Hence a partial explanation of the fact which statistics fully establish, that the proportion of choreic boys to girls is about in the ratio of one to two and a fraction. I have remarked, in this city, the large proportion of cases in school-girls between the ages of six and twelve years, the severe discipline and confinement of the public schools no doubt increasing the strength of the emotions, and weakening the control of the will over the muscles.

Proportion of Males to Females.

27 to 73.	Hughes's Digest of Cases in Guy's Hospital, 1846.
138 to 393.	M. Sée.
50 to 94.	Out-door department, Bellevue.
276 to 499.	Children's Hospital, London West (Lumleian Lectures).
491 to 1059 = 1 to 2.15.	

The cases treated in the Out-door Department, Bellevue, since those contained in the above table occurred give a larger percentage of females. Between April, 1878, and December, 1883, 288 choreic cases were treated in this department, and of these the proportion of boys to girls was 1 to 2.4 (Chapin).

Uterine Irritation.—The peculiar changes occurring in the female at puberty constitute an important cause. Hence another reason of the excess of female cases. Dysmenorrhœa and pregnancy are causes of a large proportion of cases in the first years of puberty. In the male, on the other hand, the changes of puberty do not appear to increase the liability to the disease, directly or indirectly, and male cases after the age of twelve years are comparatively rare. Radcliffe[1] states that after the ninth year females are more liable to chorea than males, in the proportion of 5 to 2, while before the ninth year the two sexes are equally liable to it. Carefully prepared statistics, however, notwithstanding the high authority of Radcliffe, show a preponderance of girls under the age of nine years, though not so great as over that age. In the Out-door Department at Bellevue, of 35 patients under the age of ten years, 22 were girls, while of 20 from the age of ten years to sixteen, 15 were girls.

According to West,[2] in 775 children with chorea under the age of ten years treated in the London Children's Hospital, 64 per cent. were girls.

Anæmia.—Among the most common predisposing causes of chorea is anæmia. It is present in so large a proportion of cases, exhibiting itself by pallor of the countenance and other characteristic signs, that medicines designed to improve the quality of the blood are among the most efficient remedies. The peculiar neuropathic state already alluded to, which needs only a slight additional cause for the development of chorea, is no doubt largely dependent on impoverishment of the blood, if it be not sometimes due entirely to it. Among the poor of a large city like New York or in hospital practice the proportion of anæmic cases of chorea is, for obvious reasons, much larger than would appear from the general statistics.

Rheumatism.—Dr. Copeland, M. Bouteille, and afterward M. Germain Sée in a more extended monograph, directed the attention of the profession to rheumatism as a cause of chorea. Subsequent observations have established the fact that rheumatism or the rheumatic diathesis is so frequently present that it obviously sustains an important relation to chorea, though in what manner is not fully ascertained. This relation between the two is more frequently observed in some countries than in others. In England and France so large a proportion of choreic patients present a history of rheumatism, either in themselves or family, that certain physicians of these countries believe that rheumatism is the most common cause of the disease. In

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[1] *Reynolds's System of Medicine.*

[2] *Lumleian Lectures.*

Germany, on the other hand, according to Romberg, in the majority of cases no relation can be traced between chorea and rheumatism. Probably the largest number of choreic cases treated in one institution in this country is in the Bureau for the Relief of the Out-door Poor in this city; and it has been our practice during the last few years to examine each patient for heart disease and question the parents as regards rheumatism. Without referring to the exact statistics, I should say that more than half give the history of rheumatism in themselves or parents or had unequivocal signs of heart disease. One of the physicians of the class found that 22 in 38 consecutive cases of chorea gave the history of rheumatism or of heart disease in themselves or parents.

Various theories have been promulgated in explanation of the relationship of the rheumatic and choreic diseases. It has been suggested that chorea is due to rheumatism of the brain or spinal cord. This is simply an hypothesis, the truth or falsity of which can only be ascertained by carefully conducted necropsies; but the theory appears improbable in view of all the facts. Another theory attributes chorea to the state of the blood which is present in those having rheumatism or the rheumatic diathesis, as well as in certain other conditions. This theory is enunciated by Dr. Ogle, as follows: "Recognizing the frequent existence of these fibrinous deposits or granulations on the heart's valves in chorea, I should be much inclined to look upon these post-mortem appearances rather as results of some antecedent general condition of the blood common also to the choreic condition. It is very freely recognized that this affection is frequently, in some way or other, connected with that condition of blood which obtains in what we call anæmia or that existing in rheumatic constitutions. In both of these states we know that the fibrin of the blood is much in excess (as also it is in pregnancy, another condition looked upon as obnoxious to chorea); and in these states we know that the fibrin with which the blood is surcharged is very prone to be readily precipitated, either owing to its superabundance or from other obscure and acquired properties, ... upon the heart's walls or valves. May not this hyperinosis be the explanation of the coincidence alluded to?"[1]—namely, the occurrence of chorea in those affected with rheumatism. Others still hold that chorea is the result of the heart disease, and not directly of rheumatism, occurring when the heart is affected from other causes as well as when the lesion has a rheumatic origin. This theory is plausible, and probably to a certain extent correct. Heart lesions observed in children result from scarlet fever in a considerable proportion of cases, though it is true that the endocarditis and pericarditis of scarlet fever are believed often to have a rheumatic origin, occurring in some instances from scarlatinous rheumatism, but in other cases from scarlatinous uræmia. Occasionally also the heart disease appears to have occurred independently of both rheumatism and scarlet fever. Thus in a fatal case of chorea with valvular disease related to the London Pathological Society, April 6, 1869, the child was always healthy up to the present illness (chorea), and there was no history of rheumatism in the family. The more observations accumulate the more important does heart disease in itself appear as a cause of chorea. In nearly all recorded cases of fatal chorea which were supposed to be due to rheumatism, and in which post-mortem examinations were made, endocardial and usually valvular disease has been found. We shall see that certain eccentric causes of irritation aid in producing chorea, and may not the valvular disease or the endocarditis which causes the valvular lesion operate in a similar manner as a cause? We know that in the adult severe cardiac disease often profoundly affects the nervous system, perhaps in consequence of the irregular and embarrassed circulation, and certainly in the child a similar cause would be likely to produce a more decided effect.

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[1] *British and Foreign Med.-Chir. Rev.*, January, 1868.

But there is an ingenious theory which attributes chorea to minute emboli detached from vegetations on the valves, and arrested by capillaries in the corpora striata or other portion of the cerebro-spinal axis. Since attention was directed to this matter, emboli have been found in one case in the medulla oblongata, although this portion of the spinal axis appeared healthy to the naked eye. Further observations are necessary in order to determine how much truth there is in this theory; but it seems probable, for reasons to be stated, that if capillary embolism do cause chorea, it is only in a limited number of cases, and that therefore those British observers who regard it as the common cause have been led into error by the large proportion of choreic cases which in their climate are complicated by valvular lesions.

That embolism is not a common cause, if indeed a cause at all, appears probable from the following facts: First. In many cases of chorea there are no vegetations or other appreciable lesions which could give rise to emboli. Secondly. Most patients recover, and some speedily, by treatment, which we would not expect if the cause were embolism. Thirdly. Embolism is not infrequent in the cerebral vessels of the adult without the occurrence of chorea. Indeed, the conditions which produce embolism are much more common in adults than in children, while the reverse is true as regards the liability to chorea. Fourthly. Dogs sometimes have chorea, but the injection of minutely divided fibrin or other substance into the veins of the dog is not followed by chorea as one of the phenomena. Fifthly. Were capillary emboli the cause, we would expect to find an occasional embolus in the larger vessels of the brain, so as to be appreciable to the naked eye; but I find no examples of this in all the recorded autopsies which I have been able to consult. Moreover, it seems improbable that capillary embolism, when producing no lesion appreciable to the naked eye, would so arrest the circulation and disturb the function of the brain or spinal cord as to cause chorea, for the ill-effects of such an obstruction would be likely to be obviated by the numerous anastomoses.

In 1877 the unusual opportunity occurred in my asylum practice of determining whether there are any fixed anatomical characters in the cerebro-spinal axis in chorea; in other words, whether chorea is a neurosis, as we have designated it in our definition, and the case is so interesting in other respects that I shall relate it entire:

CASE.—Charles ——, a foundling, born October 15, 1874, was received in the New York Foundling Asylum soon after his birth. When two weeks old he was removed to a family in the city to be wet-nursed. His health continued good till the age of three months, when he had bronchitis and keratitis, the former mild and lasting only a few days, but the latter continuing nearly two months, being attended by moderate injection of the conjunctiva, with some purulent discharge, which caused adhesion of the eyelids during sleep. From this time he remained well, with the exception of a slight attack of dysentery, till the age of about nine and a half months, when he began to have febrile symptoms. In the morning hours he seemed in tolerable health, but at mid-day or a little later than mid-day of each day he was observed to have slight irregularity or embarrassment of respiration, and lividity, with coolness of the extremities; which state, supposed at the time to be the algid stage of a somewhat irregular intermittent fever, lasted from one to two or three hours, and was succeeded by fever, which continued during the remainder of the day; sometimes the fever abated in perspiration.

On August 4, 1875, a few days after the commencement of these irregular febrile symptoms, Charles was brought to the dispensary of the institution for treatment, and Dr. Reid, who was on duty that day, carefully examined the case and prescribed the sulphate of quinia. This medicine, continued a few days, lieved the symptoms, but every four to six weeks, for more than a year, the brile attacks returned, and were uniformly relieved by the same medicine. In ther respects the patient had the usual health.

On or about February 1, 1878, the nurse noticed that Charles had what she signated "spells of trembling," in which he seemed excited and feverish, and hich were sometimes attended by or followed by perspiration. In the course f another week the irregular muscular movements became more marked and onstant, and they increased in severity till near the time of the admission of he patient into the asylum, about March 1st. The nurse had noticed in February slowness and some difficulty of micturition, and Dr. Reid examined him with a catheter for calculus, and also his prepuce for any source of irritation, but nothing abnormal was discovered, either in the condition of the bladder or the external organs. In the latter part of April the chorea had become so severe that irregular muscular action occurred in all the limbs and in the muscles of the eyes, producing such grimaces and contortions, with strabismus, that the woman with whom he was boarding became alarmed, and returned him to the asylum, stating that he had become crazy.

On March 12th my attention was first called to this child, when I made the following entry in my note-book: Family history unknown; no history of rheumatism in patient's case; he may or may not have had it; heart sounds normal; pulse 104; all the limbs and the muscles of the face, eyes, and eyelids involved in choreic movements, which continue constantly except during sleep. The patient cannot walk or stand without support; appetite good, apparently better than in health, for he eats every kind of food handed to him, and carries the food with his own hand to his mouth, although these movements are very irregular and jerking. Three drops of Fowler's solution ordered after each meal.

March 17th.—Condition not much changed, but perhaps slight improvement; in addition to other choreic movements the eyes twitch spasmodically; pulse 84, temperature 98½°; bowels irregular; no cough; appetite good. Increase medicine to five drops.

30th.—The urine examined since the last record was found very pale and abundant; its specific gravity low, 1004, without albumen. When an equal quantity of nitric acid was added to it, after twelve hours crystals of nitrate of urea occupied about one-half of the volume of the urine. The patient's sleep is quiet, but the choreic movements recommence as soon as he awakens, but in a milder form; is able to walk without support, but with unsteady gait. My term of service ended March 31st. On the following day laryngo-tracheitis was suddenly developed, ending fatally in forty-eight hours at the age of two years five and a half months.

Autopsy, April 4th.—Slight œdema about the aperture of the glottis; general and intense redness of mucous membrane of larynx, trachea, and bronchial tubes; as far as they can be traced, posterior portions of lungs greatly congested. The heart, lungs, brain with one eye attached to it by optic nerve, and the entire spinal cord were sent to Prof. Francis Delafield, for microscopic examination. They were, as soon as removed, placed in a solution of bichromate of potassium. The following is a brief statement of the examination which was made:

Microscopic Appearances. By Prof. Francis Delafield.—*Brain* presented no change apparent to the naked eye except a considerable degree of congestion. It was hardened in bichromate of potassium and chromic acid. Minute examination of the convolutions of the brain, the large ganglia, the cerebellum, the pons Varolii, and the medulla oblongata showed nothing except a uniform filling of the vessels with blood, as if they were injected. There were no apoplexies, no changes in the walls of the vessels.

Spinal cord appeared to be entirely normal.

The Heart.—The auricles and ventricles were of normal size. The aortic valves were atheromatous and somewhat rigid; the mitral valves were thickened and insufficient; the endocardium of the left ventricle was thickened.

The Lungs.—The capillaries in the walls of the air-vesicles were dilated, and there was an increase of epithelial cells within the air-vesicles.

In this case there seemed to be no lesion associated with the chorea except the organic disease of the heart and the changes in the lungs secondary to this condition of the heart.

The above microscopic examination was made with sufficient minuteness, and it is seen that no emboli were discovered and no lesion of the cerebro-spinal axis except congestion, which was attributable to the mode of death—namely, by obstructed respiration. Moreover, it will be recollected that there were no cardiac *bruits*, and apparently not sufficient roughness of the edge or surface of the valves to cause precipitation of fibrin, which would be necessary in order that emboli should form.

Fright.—A not infrequent cause of chorea is sudden and profound emotion, especially fright. All statistics give fright as the cause of a certain proportion of cases, though there are usually other potential co-operating causes, as anæmia or valvular disease. Fright was stated as the cause of chorea in 31 of the 100 cases occurring in Guy's Hospital reported by Hughes, or nearly 1 in 3. But the statistics of other observers do not give so large a proportion of cases originating in this way. Chorea may commence within a few hours after the fright or not till the lapse of several days (eight or ten). If several weeks have passed since the fright, as in some reported cases, the chorea is probably due to other causes. In rare instances chorea is said to have been caused by sudden and excessive joy.

Imitation.—Under unusual circumstances, especially in a state of great mental excitement, imitation has been known to cause a form of chorea. Hecker describes an epidemic of it occurring in the Middle Ages and spreading through villages. In modern times it is rare that chorea originates from this cause, nevertheless occasional examples have been recorded.

But the disease which occurs from imitation differs from the ordinary form and has been termed chorea major, while the chorea which is the subject of this article is sometimes designated, in contradistinction, chorea minor.

In chorea major the patient leaps, dances, or whirls like a top. It has its origin commonly in religious excitement, and spreads by imitation almost in the manner of an infectious disease. The epidemic of the Middle Ages was a chorea major. I have not been able to find any account of cases spreading by imitation in modern times which were not examples of the same form of chorea. Thus in the *Edinburgh Journal of Medicine and Surgery*, for July, 1839, there is a clear description of chorea major occurring successively in five children in the same family. Dr. Dewar, the attending physician, states that one of the children whom he was called to see was sitting near the fireplace, when her head dropped on her chest and she appeared to doze some minutes. In the mean time the respiration became a little accelerated, the face altered and flushed, the eyes wild. In less than one minute she bounded from one extremity of the apartment to the other, leaping over chairs, a chest, and then throwing herself upon the floor; she attempted to stand upon her head, rolled upon the floor, and then, rising, ran with extreme swiftness in the room, till she finally fell again upon the floor, where she remained motionless some minutes. Then, recovering, she noticed those who surrounded her, and asked of her sister a toy which she had allowed to fall. The whole paroxysm lasted twenty minutes.

Obviously, the symptoms of chorea major differ materially from those of chorea minor, and it is a question whether it should have the same generic name. It is a curious and interesting disease in its psychical and pathological aspect, but it is so rare in modern times that a knowledge of it is of little practical importance.

Intestinal Irritation.—In rare instances intestinal worms cause chorea, though in these cases there have usually been some co-operating causes. The following is an example related by Mr. Ogle:[1] "Ellen L——, nine years old, had been under treatment about a month with chorea, rheumatism, and worms. She had not slept in four days, and there was constant spasmodic movement of the body and face. Her general condition was very unpromising. As she had passed portions of a tape-worm at intervals during the last three months, one drachm of the oleum filicis maris was administered in mucilage, which caused the expulsion of the entire worm. From that time she fully and rapidly recovered from the chorea, though a mitral murmur remained."

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[1] *Lond. Medico-Chir. Rev.*, Jan., 1868.

Lesions of Brain and Spinal Cord.—Although we reject the theory that cerebral emboli are the common cause of chorea, and believe that in a large majority of cases there are no cerebro-spinal lesions, nevertheless experiments and also occasional cases establish the fact that if not true chorea, at least choreiform movements now and then result from a structural affection of the nervous centres.

Experiments on certain of the lower animals demonstrate that irregular muscular movements may be produced by traumatic injury of certain portions of the cerebro-spinal axis, as the corpora quadrigemina, crura cerebri, pons Varolii, crura cerebelli, thalami optici, parts of the medulla oblongata, and the upper portion of the spinal cord. Pressure on the projecting part of the medulla oblongata of an acephalous monster also causes convulsive movements. At the meeting of the New York Academy of Medicine, April 20, 1871, Professor Post related the case of a child who was struck over the occiput with a billet of wood, and chorea followed, due, in all probability, to the injury of the brain which resulted.

If irregular muscular movements, choreic or choreiform, result from traumatic injury of certain portions of the nervous centres, may they not also occasionally occur from lesions of the same parts produced by disease? Sir Benjamin Brodie[1] relates the case of a choreic girl dying in St. George's Hospital, in whom, after a careful post-mortem examination, the only morbid appearance observed was a tumor the size of a hazelnut connected with the pineal gland. Dr. Broadbent[2] described another case before the London Pathological Society in which a tumor was found arising from the centre of the spinal cord; and Chambers one in which tubercles were imbedded in the cord. Romberg quotes from Frerichs a case in which the medulla oblongata was pressed upon by an enlarged odontoid process; and Dr. Aitkin[3] one in which the specific gravity of the thalamus opticus and corpus striatum was greater on one side than on the other. Rilliet and Barthez relate other similar cases, and they remark: "We may conclude from these different cases that there exist two species of chorea—the one essentially a simple neurosis, while the other depends on an alteration of the encephalo-rachidian system. In a word, it is of chorea as of convulsions, that it is sometimes idiopathic, sometimes symptomatic." Still, the cases in which it is symptomatic are so few that it is proper to consider chorea, as it ordinarily occurs, one of the neuroses until the microscope detects some anatomical cause in the cerebro-spinal system of which we are now ignorant.

ANATOMICAL CHARACTERS.—We have seen that chorea has no constant anatomical characters. Lesions which probably sustain a causal relation to the disordered muscular action are sometimes present, and others are sometimes observed which are neither a cause nor a result, their presence being a coincidence. But there are two lesions which, though often absent, have been observed in so large a proportion of fatal cases that they are justly regarded as an occasional result when chorea is severe. Dr. Hughes of London collected records of the post-mortem appearances of 14 cases, with the following result as regards the cerebro-spinal axis: Brain, 14 cases; healthy,

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[1] *London Lancet*, Dec. 19, 1840.

[2] *Transactions London Pathological Society*, vol. xiii. p. 246.

[3] *Glasgow Medical Journal*, vol. i.

4 cases; only congested, 3 cases; softened in part or entirely, 6 cases (some of these 6 also congested). In some of the 14 cases those occasional results of congestion—to wit, transudation of serum and extravasation of blood in greater or less quantity—were also observed. Spinal cord: healthy, 3 cases; congested, 2 cases (one slightly, in the other the engorged vessels were large and numerous); softening in medulla oblongata, 1 case; softening opposite fourth and fifth vertebræ, 12 cases. In 1 there was soft, in another firm, adhesion of the spinal meninges, and in 1 it is stated that the rachidian fluid was opaque. Of 16 fatal cases of chorea occurring in St. George's Hospital "congestion (more or less complete) of the nervous centres (brain or spinal cord, or both) was met with in 6 cases." Softening of certain parts of the brain was observed in 1 case, and of the spinal cord in another.[1] Other statistics of the anatomical character of fatal chorea correspond, in the main, with those of Hughes and Ogle. The lesions observed by them are probably not present in ordinary cases, occurring only when the choreic movements are so severe that the patient is deprived of needed repose and the important functions of the economy, as circulation and nutrition, are seriously disturbed.

The post-mortem examination of other parts besides the cerebro-spinal axis furnishes a negative result, if we except such affections as have been ascertained to act as causes of chorea. What portion of the nervous centre is chiefly involved in chorea is uncertain. Some, as Sir Benjamin C. Brodie,[2] consider chorea a disease of the nervous system generally, while others have attributed it to disease or disorder of a certain part, as the corpus striatum, cerebellum,,etc. Finally, it is stated that in late experiments on choreic dogs the movements do not cease when the spinal cord is severed from the brain, nor also on division of the posterior roots of the spinal nerves.[3] In these cases, therefore, the part of the axis which is in fault would appear to be solely the spinal cord.

SYMPTOMS.—Chorea is partial or general. It is partial when it affects a few muscles or groups of muscles, as those of one arm, the face or neck, or of one eye. It is designated general when all the limbs and certain of the muscles of the face and trunk are involved. Statistics show that partial chorea occurs more frequently on the left than on the right side, and in general chorea the movements on the left side usually predominate. The commencement is in most cases gradual. Even when finally chorea becomes general, certain muscles only are affected in the commencement in ordinary cases. The child in whom this disease is about to begin is observed to be fretful and impatient from slight causes, and the irregular muscular action is sometimes misunderstood by the parents, who reprimand him for his supposed fidgety habit. In exceptional instances, especially when the cause is a sudden and profound emotion, the commencement is abrupt and the disease is severe and general from the first.

In a majority of cases the muscles which are primarily affected are those of the face, neck, fingers, or hand on the left side. Sydenham erred, unless the clinical history of chorea has changed during the last two centuries, when he stated as the common fact that a tottering gait is its first manifestation, but now and then such a case does occur. Whenever choreic movements appear other muscles besides those first affected are soon involved, so that in the course of a few weeks, sometimes of a few days, all the muscles that participate are engaged.

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[1] Ogle: *Brit. and For. Medico-Chir. Rev.*, Jan., 1868.

[2] *London Lancet*, Dec. 19, 1840.

[3] Legros et Onimus: Rech. sur les mouvements choreiformes du Chien, Acad. des ci., 9 Mai, 1870, *Lyons Méd. Jour.*, June 5, 1870.

A muscle affected by chorea alternately contracts and relaxes, but less forcibly and rapidly than in eclampsia, and the movement is partly controlled by volition. This produces an unsteady and tremulous action of the part, whether a limb, the neck, or the face, which at once arrests attention and indicates the nature of the disease. The result is similar, as regards the muscular action, whether the patient wills a movement or attempts to control those which chorea produces.

If the case be of ordinary severity, the movements continue with but momentary intermissions, except during sleep, when they ordinarily cease. In grave cases patients are often deprived of the proper amount of sleep in consequence of the severity and persistence of the muscular action, and in exceptional instances, especially when the result is fatal, the movements continue in sleep, but the sleep is not sound and is frequently interrupted. In profound sleep the muscles are always in repose.

The older writers have left us graphic descriptions of those diseases which have striking external manifestations, though often with somewhat of exaggeration. Sydenham says of chorea: "The patient cannot keep it (his hand) a moment in the same place; whether he lay it upon his breast or any other part of his body, do what he may, it will be jerked elsewhere convulsively. If any vessel filled with drink be put into his hand, before it reaches his mouth he will exhibit a thousand gesticulations, like a mountebank. He holds the cup out straight, as if to move it to his mouth, but has his hand carried elsewhere by sudden jerks. Then, perhaps, he contrives to bring it to his mouth, and if so, he will drink the liquid off at a gulp, just as if he were trying to amuse the spectators by his antics."

In severe general chorea a similar description is applicable to the movements of the legs and features. Grimaces and distortions of the features occur, while the gait is halting and unsteady, or it is impossible to walk, and the patient lies or sits. The speech is slow, thick, and indistinct in consequence of the muscles of the tongue and larynx becoming engaged, and even mastication and deglutition are rendered difficult. The imperfect speech in chorea is attributed partly, however, to the mental state in severe protracted cases. Chorea, except when mild, is accompanied by other symptoms referable to the nervous system. More or less impairment of the mental faculties occurs in chronic cases when severe, exhibiting itself in dulness or apathy. The countenance sometimes presents in aggravated cases almost the appearance of idiocy. The muscles, instead of becoming hypertrophied and more powerful by their frequent contraction, grow softer, more flabby, and weaker. Indeed, a partial paralysis sometimes results, so that a degree of numbness is experienced in the affected part and the limb when raised cannot be sustained. Pain is not a symptom of chorea, but fugitive rheumatic or neuralgic pains are sometimes experienced. Derangement of the digestive function, exhibited by a poor or capricious appetite, constipation, etc., are common.

In rare instances chorea affects the respiratory muscles so as to produce a peculiar involuntary barking or squeaking voice by the forcible expulsion of air over the tense vocal cords. In a case treated by Dr. L. C. Gray in the N. Y. Polyclinic the patient, a boy of fifteen years, had been choreic since his seventh year, and chorea in its usual form had continued one year when the barking sound commenced, and this has continued until the present time. Dr. French of Brooklyn also treated a similar case, having the following history: A boy of nine years had choreic twitchings of the facial muscles at the age of five years. After continuing several months, they ceased during an entire winter, after which the peculiar sound of the voice, resembling the squeak of a young turkey, commenced. It occurred at the beginning, middle, or end of respiration. It alternated with choreic movements of other parts of the system, so that when they ceased it returned. By the laryngoscope the irregular action of the vocal cords was observed, but the expiratory muscles of the chest were also involved, so as to produce the peculiar sound by the forcible expulsion of air. In Dr. French's case these vocal sounds ceased, except at rare intervals, after three months of medicinal treatment.[1]

The urine of choreic patients has been examined by Drs. Walsh, Ford, Bence Jones, Handfield Jones, Radcliffe, and others, and its elements have been found in most cases to vary from their normal quantity. Dr. Handfield Jones[2] read a paper before the Clinical Society of London in 1871 on two cases of chorea in which he had made careful chemical analysis of the urine with the following result: During the height of the disease the amount of the urine was much in excess of what it was when the disease had ceased; the urea excreted during the choreic period was in excess, as was also the phosphoric acid excreted when the choreic symptoms were at their maximum, but the quantity of this acid was less than the average during convalescence; a moderate amount of uric acid during the disease was also observed, but none upon recovery.

PROGNOSIS; COURSE.—Chorea, though obstinate and often incurable in adults, usually terminates favorably in children in two to four months. Bouchut considers its ordinary duration at from thirty to fifty days, which is certainly shorter than the average duration in this country, except when the disease is materially abridged by treatment. The same author states that it may continue only a few days, as he has observed in cases which occurred during convalescence from scarlet fever. But tremulousness of the muscles, occurring in the state of weakness following a grave disease and abating as the general health is restored, I should not consider as properly choreic, any more than that occurring from over-fatigue. As the choreic movements gradually increase in the initial period till a certain maximum is reached, so their decline is gradual. Temporary variations also occur throughout the disease as regards the extent of the movements, which are aggravated by mental excitement, bodily fatigue, certain functional derangements, especially of digestion, and sometimes from causes which are not apparent.

Though, as a rule, chorea in children ordinarily terminates favorably under different and even injurious modes of treatment, there are exceptional cases. Romberg relates the history of a patient who died at the age of seventy-six years, having had chorea since the age of six years. In chorea limited to a few muscles or a group of muscles the prognosis is more doubtful than when it affects a large number, since in the former case the cause is more likely to be some lesion of the cerebro-spinal axis. Thus, chorea involving only certain muscles of the neck or of the eyes is sometimes due to this cause, and is then very obstinate.

Again, observations demonstrate that chorea, when at first, in all probability, strictly a neurosis, but of a protracted and grave character, may give rise to a central organic disease. This is the course of most of the fatal cases, congestion, softening, or other lesion occurring over a greater or less extent of the nervous centres. Radcliffe has known cerebral meningitis to supervene in two instances. With the occurrence of a lesion of the cerebro-spinal axis new symptoms arise, such as headache, convulsions, delirium, and paralysis, and the choreic movements cease or continue according to the nature of the lesion.

Chorea, like certain other diseases either of a nervous character or having a nervous element, is more or less modified by intercurrent inflammatory and febrile affections. The oft-quoted expression from Hippocrates, *febris accedens solvit spasmos*, observations show to be founded in fact, the most frequent example of which occurs in pertussis. In chorea the movements, as a rule, are either rendered milder or they cease as long as the febrile excitement continues: but there are exceptions, and the subsequent course of the disease is not modified.

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[1] *N. Y. Med. Record*, Dec. 15, 1883: Dr. Chapin.

[2] *London Lancet*, July, 1871.

DIAGNOSIS.—This is not difficult in ordinary cases. The irregular movements with consciousness preserved enable us to make a diagnosis at sight. In its commencement and when it continues in an unusually mild form chorea may be overlooked by the physician, as it often is by the parents, the movements being attributed to a fidgety habit; but medical advice is seldom sought till the movements are so pronounced that it is impossible to err, except through gross ignorance or carelessness.

It is important to determine when chorea merges in an organic disease, and also whether there is a local cause of the chorea. A careful and intelligent study of the symptoms and history of the case is requisite in order to a correct diagnosis in these particulars.

TREATMENT.—*Regimenal.*—As chorea in a large proportion of cases occurs in a state of anæmia, and the vital forces are ordinarily more or less reduced, obviously the regimen should be such as invigorates the system. Fresh air and outdoor exercise, active or passive according to circumstances, with the avoidance of undue excitement, are requisite, and the diet should be nutritious, but plain and unirritating. The various functions should be preserved so far as possible in their normal state. In exceptional instances, when the choreic movements are violent, the patient should lie in bed, and the muscular action, if so constant and excessive as to deprive him of the requisite sleep, should be restrained by light and well-padded splints.

Medicinal.—Sometimes among the co-operating causes is one of a local nature which is susceptible of removal, as a carious and painful tooth, intestinal worms, etc., and measures calculated to effect this are obviously required. Allusion has already been made to a case in which the employment of the oleo-resina filicis and the expulsion of a tape-worm effected a speedy cure.

The remedy which has been most employed in chorea, and which in consequence of the anæmia is plainly indicated in a large proportion of cases, is iron. It does not interfere with the employment of other remedies which have a more specific effect. Nearly all the ferruginous preparations have been prescribed in different cases with benefit. Radcliffe gives the preference to the iodide of iron, believing that iodine as well as iron exerts a curative influence. I have prescribed the ammonio-citrate, since it is easy of administration in simple syrup and is well tolerated; but I now prefer liquor ferri peptonati, recently introduced from Germany. It should be given in doses of one to three teaspoonfuls three times daily.

But iron must not be regarded as the main remedy, but rather as an adjuvant. Observations during the last few years in both continents have more and more established the claims of arsenic to be regarded as the most efficacious of all medicinal agents in the treatment of chorea. Properly administered, it abridges the duration of this disease more certainly than any other agent, and within a few days begins to modify the choreic movements in the severest cases. It is conveniently given in the form of Fowler's solution. It is better tolerated by children than by adults, and should be administered to them in a larger proportionate dose. A child of eight years can take five drops, diluted in water, three times daily after eating, and the dose may be increased, if needed, to eight, ten, twelve, or even fifteen drops. I seldom observe any gastric irritability or other unpleasant effect from its use when it is administered largely diluted and after the meals, but if such occur, it should, of course, be suspended for a time.

While not hesitating to recommend iron and arsenic as superior to all other medicines in the treatment of chorea, it is not proper to ignore the opinions of other members of our profession who have had ample experience and recommend other agents instead.

Trousseau gave the preference to strychnine, increasing the doses in some cases until it began to produce its poisonous effects.

Professor Hammond[1] says: "My main reliance is on strychnia, which, I think, should be given in gradually increasing doses, somewhat after the manner recommended by Trousseau. . . . . This plan of treatment certainly shortens the duration of the disease very materially, and causes great improvement in the general health of the patient. Sometimes the effect is so well marked and is so immediate that it is not necessary to increase the doses to the extent of causing muscular cramps, but generally the full therapeutical effect of the drug is not obtained till the calf of the leg or the nucha has slight tonic spasm. I have never seen the slightest ill-consequences follow this mode of treatment, and the doses are increased so gradually that with careful watching danger need not be apprehended." Dr. Hammond has treated thirty-two children with this agent without a single failure.

But as chorea terminates favorably with smaller and safe doses, even if the time required be longer, it does not seem proper to recommend its employment to the extent of producing physiological effects for general practice. Bouchut, speaking upon this point, says: "But with these precautions strychnia is extremely dangerous, for I have seen at the Hôpital des Enfants Malades a young girl of thirteen years die in tetanus" produced by an increased dose of this drug (article on Chorea). Dr. West, in his Lumleian Lectures, also says: "I have seen one instance in which its employment, while it failed to benefit a somewhat severe case of chorea, was followed by two attacks of violent tetanic convulsions, which nearly proved fatal;" and he adds: "The twitching of the limbs of itself prevents our becoming aware of the dose being excessive." Therefore, Dr. West does not favor the employment of this agent. Still, any agent may be given in an overdose, and it is not difficult to prescribe strychnia in a dose which may be efficient, and yet safe for children, at the age at which chorea ordinarily occurs.

I have employed bromide of potassium in a few cases, but with so little benefit that I am not inclined to continue its use for this disease. Others have not been more successful. However efficacious the bromide may be in epilepsy, it does not appear to be a remedy for chorea.

Cimicifuga, first employed by Jesse Young of this country, is highly esteemed by Philadelphia physicians in the treatment of chorea. I have employed the fluid extract in doses of half a drachm, increased to one drachm, for a child from six to ten years of age, and, though it benefits some cases, it has no appreciable effect either in moderating the movements or abridging the duration of others.

Ether, asafœtida, valerian, musk, the oxide and sulphate of zinc, turpentine, tartar emetic, opium, and numerous other remedies have been recommended, and some of them have seemed useful in certain cases. In this city sulphate of zinc has been frequently employed as a remedy for chorea, and in gradually increasing doses till more than twenty grains were administered three times daily; but it has not appeared, so far as I have been able to ascertain, to exert any marked influence either on the severity or duration of the choreic movements. Justice, however, requires us to state that Dr. West, who has written recently on the nervous diseases of children, thinks that it has been beneficial in certain cases in which he has employed it, and he regards it on the whole as the best remedy.

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[1] *Diseases of the Nervous System*, page 617.

cliffe, who has had ample experience in the treatment of nervous s, writes: "In an ordinary case of chorea the plan of treatment have now adopted as a rule for some time is to give cod-liver oil in ion with hypophosphite of soda, making the draught containing the lt the vehicle for the administration of the cod-liver oil." Some-mphor or the sesquicarbonate of ammonia is added. Of more than ses treated in this way, the average duration was under three weeks. began to prescribe these remedies on theoretical grounds, believing sphorus and cod-liver oil were required to restore "nerve-tone," and lt of this treatment has certainly been such as to commend it to the n. To children he gives from five to eight grains of the hypophos-sodium three times daily.

ose severe cases, in which choreic movements prevent the proper of sleep, a moderate dose of hydrate of chloral may occasionally be eously administered.

ricity has been many times employed in the treatment of chorea, gh some, chiefly electricians, believe that it has a curative effect, nd the majority, fail to see any material benefit from its use.

general baths, the shower-bath, frictions along the spine, etc. have ployed; but the local treatment which has so far been most success-which promises to supersede all other local measures, consists in the on of ether spray over the spine. About two ounces of ether are l at each sitting, the spray being applied from an atomizer up and whole length of the spine if the chorea be general. The opera-ch occupies from ten to fifteen minutes, should be repeated daily second day. A considerable number of cases have been reported the spray has apparently had a good effect in controlling the dis-ut I repeat my belief, from the large number of cases seen in the or the Relief of the Out-door Poor, that the arsenical and ferrugi-atment gives more satisfaction than any or all other measures.

CHAPTER XV.

PARALYSIS.

LYSIS in young children, especially infants, is in most instances due which seldom produce it in adults. The principal cause of it in the amely, cerebral apoplexy—is indeed rare in children. Paralysis in has the following recognized causes: 1st. A change in the blood, understood, induced by certain grave diseases, as diphtheria, typhoid easles, scarlet fever, etc. 2d. Reflex influence. The function of t of the system is in some way disturbed, and paralysis occurs in uscles, perhaps at a distance from the cause, and it disappears when e is removed, unless it have continued too long. The only rational on is found in the fact of a continuous connection between the local l the paralyzed muscles through the afferent and efferent nerves and ous centres. 3d. Compression or injury of a nerve-trunk. These rare. Pressing of the portio dura by the blades of forceps during scribed in the next chapter, is an example. 4th. An anatomical in the muscular fibres, the nerves and nervous centres remaining l. This has been designated myogenic paralysis. This form of

New York Foundling Asylum about the 1st of September,
be in good health and was plump and well-developed, an
that she had had no serious sickness. After her admissio
having the usual appetite, amusing herself through the da
symptoms to attract attention till December 6th. On the
5th she ate her supper as usual, and was placed in her crib
health. At 3 A. M. the sister who was in charge of the ward
general eclampsia. Immediately, in addition to the usual
administered five grains of bromide of potassium, and this
vals till six or seven doses were administered. Neverth
movements continued, with more or less violence, till 1½ P. M
of the leg somewhat longer.

On my arrival at the asylum, at about 6 P. M., I fou
rather stupid, but easily aroused. Her vision was evident
conscious; the pupils responded to light and the direction
mal; pulse 104, no cough, and respiration natural; tempe
by the thermometer in the axilla, also normal. There was
of the muscles of the face, but the right arm and leg were
paralysis was not complete. The great toe flexed on tickli
but the foot itself had little or no motion, and on my atte
which was extended, some rigidity of the muscles was ob
patient produced slight movement of the thigh upon the tr
the right upper extremity were more flaccid than those of
of the forearm was totally lost, while a little movement re
the trunk. During the two or three days succeeding the co
the right limbs did not appear to be entirely lost, tho
Subsequently paralysis in the right limbs, both of the ne
motion, was nearly or quite total, and continued so till
tickling the sole of the foot caused some movement of the
side sensation and motion were perfect.

The record of December 9th runs: Has vomiting to-d
apparently sees well, and appearance of the eyes normal
head or rigidity of muscles of neck or along the spine; pu
the axilla normal; lies quiet and with eyes shut; is stupid,
aroused; the bowels move regularly.

December 11th, continues to vomit at intervals; pulse
80, temperature 100°; vomited once yesterday, none to-d

at intervals; a rash like lichen over abdomen and chest, possibly due to the large quantity of bromide of potassium administered. 24th, pulse intermittent; pupils dilated.

Dec. 25th, died in profound stupor to-day, having lived nineteen days from the commencement of the malady.

Autopsy.—About thirty hours after death, weather cool. On removing the calvarium and dura mater, which presented no unusual appearance, the vessels of the pia mater were found rather more injected than usual, but not more so than we sometimes observe in those who die of diseases which do not involve the brain. The cerebro-spinal fluid was scanty and the surface of the brain rather dry. The vertex of the left hemisphere was unusually prominent, rising perhaps half an inch higher than that on the opposite side. At the highest point, which was about one and a half inches from the median line, was a circular yellowish spot upon the surface of the brain about one and a half inches in diameter. Pressure upon this spot, made lightly so as not to produce rupture, communicated the sensation of a large cavity underneath filled with liquid and approaching to within two or three lines of the surface. There was no adhesion or exudation over this spot, and the surface of the brain appeared entirely normal, except a little cloudiness of the pia mater over a space which could be covered by a five-cent piece, a little posterior to the optic commissure. The incised surface of the brain at a distance from the abscess showed no increase of vascularity. The right hemisphere appeared in every way normal, except that its lateral ventricle was filled with pus, but not distended.

On the left side, occupying the centre of the hemisphere, was an abscess as large as the fist of a child of two years, extending from within two or three lines of the vertex, where its site corresponded with the yellow spot on the surface of the brain, to the roof of the lateral ventricle. Through this roof the abscess had burst, filling and distending the ventricle with pus, and thence making its way into the lateral ventricle of the opposite hemisphere. The whole amount of pus contained in the abscess and the two ventricles was perhaps two ounces. The walls of the left lateral ventricle were much softened, the upper part of the corpus striatum and thalamus opticus being nearly diffluent; the walls of the right lateral ventricle were slightly softened, but to less depth. The parietes of the abscess, which extended from the roof of the ventricle to the vertex, as already stated, were indurated to the depth of one and a half lines in consequence of proliferation of the connective tissue, except at the base of the abscess, which corresponded with the roof of the ventricle, where softening had occurred. The spinal cord, so far as it could be examined from the cranial cavity, had the usual vascularity and seemed nearly or quite normal.

The cause of encephalitis from which the abscess resulted was obscure. This inflammation, so far as can be ascertained, was idiopathic, which is known to be a rare disease. There was no history of otitis, which is one of the most frequent causes of cerebral abscess, nor of heart disease, so as to produce embolism. It seems probable, since there was no fever till about the fourth day after the convulsions, that an abscess had primarily occurred in the hemisphere between the roof of the ventricle and the vertex, probably weeks previously. The bursting of this into the lateral ventricles, and the constitutional disturbance, inflammation, and softening to which this gave rise, afford sufficient explanation of the history of the case after the commencement of the convulsions.

Paralysis occurring as a symptom or sequel of some obvious local or general disease, as diphtheria, lesion of the nervous centres, etc., and which may occur at any age, need not detain us. It is described in connection with the primary diseases on which it depends.

CHAPTER XVI.

POLIOMYELITIS ACUTA ANTERIOR.

THIS form of paralysis occurs, with few exceptions, between the ages of six months and seven years.

SYMPTOMS.—The previous health of the patient is usually good. The paralysis does not always commence in the same manner. In a few instances it begins suddenly in the day-time when the child is apparently in perfect health. In others it begins abruptly, after sound sleep. The child goes to bed well, sleeps through the night, and awakens in the morning paralyzed. I have known it to occur in one instance after sleep in the middle of the day. In these cases there has sometimes been an exposure before the sleep to wind or rain or from sitting on a cold stone. But in the majority of cases the paralysis is preceded and accompanied by a very decided elevation of temperature, which comes on suddenly without appreciable cause, and after a few days the power of motion is found to be lost in one or more of the limbs. No symptom occurs during the fever indicative of disease of the brain: consciousness is retained, and the headache or apparent liability to convulsions is no greater than in other pathological states accompanied by an equal amount of fever. The paralysis is at its maximum in the commencement. Occurring as by a stroke, the full extent of the paralytic state is exhibited at once, and so far as there is any subsequent change it is an improvement as regards the number of muscles affected and the degree of the paralysis. Most frequently the muscles of one or both lower extremities are affected. Occasionally one of the upper extremities is also paralyzed in addition to the lower, but paralysis of an upper extremity is less in degree, and disappears sooner, than of the lower. The bladder and lower bowel remain unaffected, since only the muscles of volition are involved. Sensation is unimpaired in the affected limbs, and in the commencement there is even in some cases a state of hyperæsthesia (West). The fever which precedes and accompanies the paralysis in certain cases gradually abates, and in a few days nothing abnormal remains except the loss of power in the affected muscles. These muscles are flaccid and relaxed, so that the limb falls by its weight when unsupported, and they are usually free from pain. The number of muscles paralyzed varies greatly in different cases. Only one muscle or a single group of muscles may be affected, or, on the other hand, both the extensor and flexor muscles of two or more limbs may be paralyzed. In the opinion of Mr. Adams, the following table exhibits the groups of muscles and single muscles most frequently involved, and in the order stated:

Groups.

1. Extensors of toes and flexors of the foot.
2. Extensors and supinators of the hand.
3. Extensors of leg, and with them usually the first group.

Single Muscles.

1. Extensor longus digitorum of toes.
2. Tibialis anticus.
3. Deltoid.
4. Sterno-mastoid.

The following is an example of infantile paralysis as it not infrequently occurs when the result is favorable: A. K——, German, female, aged three years and four months, fleshy; had been in the habit of sitting on the ground near the house and on the door-sill. On July 2, 1871, she had a sound sleep in the afternoon, having been entirely well previously, and awoke trembling and with a high fever at 3½ P. M. At 8 P. M., the febrile excitement continuing, general clonic convulsions occurred, lasting about ten minutes. At this time I was called to see her, and found her face flushed, surface hot, and pulse about 130. Consciousness returned after the convulsion. Her intelligence was good, tongue moist and slightly furred, bowels rather constipated, and the urine freely passed. The fever continued two days, when it gradually and entirely abated, but before it ceased paralysis of the left lower extremity was observed. No weight at first could be sustained upon this limb, and it hung powerless when we endeavored to make her walk. The attempt caused her to cry, as if in pain, and pressing upon the thigh or moving it had the same effect. The thigh of this limb appeared slightly swollen on inspection, but measurement did not indicate any notable enlargement. The difference in circumference was not more that one-eighth to one-fourth of an inch. There was no appreciable increase of heat in the thigh over the general temperature of the body. Sensibility remained in every part of the limb, and the loss of power was not complete, for on the first day, as soon as the paralysis was observed, slight and imperfect movements could be produced by pinching the limb. In three weeks the use of the limb was fully restored by mildly stimulating liniments and simple medicines to regulate the bowels. The tenderness which was observed in this case is only occasionally present, and has been attributed to hyperæsthesia.

PROGNOSIS; PROGRESS.—The paralysis in nearly all cases soon begins to abate. The power of motion returns little by little, and whatever improvement occurs is permanent. There is no retrogression in the convalescence. The sooner improvement commences the more favorable is the prognosis. In the most favorable cases there is complete restoration in from three to four weeks. In other patients, while certain of the muscles regain the power of motion, other muscles, oftener those of the lower extremity than of the upper, do not recover their function, and, unless proper remedial measures be employed, and even with them in certain instances, atrophy soon commences. The temperature of the paralyzed limb falls three, five, or even eight degrees, and the amount of blood which circulates in it is diminished, so that the pulse of the limb is feebler and its vessels smaller than in health. With the atrophy the contractility of the muscular fibres by the electric current diminishes, and in unfavorable cases after a time powerful induced and even primary currents have no appreciable effect. The nutrition of a paralyzed limb is always imperfect, and if the paralysis occur in a child its growth is retarded. Therefore, in cases of protracted or permanent infantile paralysis of one limb a disproportion occurs both in diameter and length between it and that on the opposite side. If the paralysis continue, the ligaments of the paralyzed limb become relaxed and lengthened. West mentions a case of paralysis of the deltoid in which the humero-scapular ligaments were so extended that the humerus dropped from the glenoid cavity, so as to increase the length of the limb three-fourths of an inch. In the paralysis of certain muscles of the lower extremity and continuance of the contractile power in others we have the conditions which give rise to club-feet, and accordingly this deformity is the common result of the paralysis when it is not cured.

ETIOLOGY.—As this form of paralysis is not fatal, opportunity for post-mortem examination in a recent case seldom occurs. Hence the difficulty in determining the exact anatomical change in the nervous system which produces the paralysis. Medical literature contains records of a considerable number of cases in which autopsies have been made, but death occurred so long after the commencement of the paralysis, usually months or years, that it is difficult to determine whether lesions which have been observed were a cause or consequence. In a majority of these autopsies a spinal lesion of some sort was detected, but in some instances none could be discovered

Mr. Adams in his treatise on club-foot relates a case in which the spinal cord, carefully examined, probably only with the naked eye, seemed normal. Robin examined the spinal cord microscopically in one case, but discovered nothing abnormal, and Elischer made autopsies in two cases of this paralysis in which death had occurred from variola, but with a negative result as regards the nervous system.[1] The examinations by Robin and Elischer, since they were microscopic, have been justly regarded as important, and they have been related by writers in order to sustain the theory that infantile paralysis is peripheral and not centric.

Very little was effected prior to 1863 in determining the cause or causes of this paralysis by post-mortem examinations, because the microscope was so little used, and because in most of the cases reported the clinical history or microscopic lesions were such as to show or to render it highly probable that the paralysis was not of the kind which we have been describing. Thus, Beraud reported a case in which tubercles were found in the spinal cord; Hammond, a case in which a clot was found in the spinal cord; and Jaccoud, one of spinal arachnitis with thickening of the meninges. Since 1863, 17 autopsies have been recorded in which the spinal cord was carefully examined, and upon these we must chiefly rely for our data by which to determine what are the anatomical changes in the nervous system which probably cause this paralysis. The reader will find these cases tabulated in a lecture by E. C. Seguin, M. D.,[2] and the most important of them narrated in a paper on infantile paralysis, showing great research, published by Dr. Mary Putnam Jacobi.[3] It is true that all but 3 of these post-mortem examinations were made many years after the occurrence of the paralysis; but in the 3 cases which were reported by Roger and Damaschino, only two, six, and thirteen months had elapsed. The following were the chief lesions observed in these cases as regards the spinal cord:

	Cases.
1. Atrophy of motor-cells in anterior cornua	10
2. Nerve-cells, normal	2
3. Atrophy (variously recorded) of anterior columns, or cornua, or part of cord, or roots of anterior nerves	8
4. Sclerosis	9
5. Myelitis, recorded as diffused, central, or slight	7
6. Central softening (the three most recent cases)	3
7. Small clot in cord (Hammond's case)	1
8. Sciatic neuritis	1

The most common lesions in these cases were those of inflammation of the anterior cornua of the spinal cord, or such as are known to result from this inflammation—to wit, atrophy of the nervous substance and sclerosis.

With the data furnished by these post-mortem examinations and the clinical histories of cases we are better prepared to consider the theories regarding the etiology of this malady. The views of MM. Roger and Damaschino are entitled to much consideration, since the autopsies which they made were in cases of shorter duration, and therefore nearer the date of the commencement of the paralysis, than those which have been reported by other observers. Roger and Damaschino[1] published a series of papers on this malady, which they conclude with the following propositions: "1. The alteration peculiar to infantile paralysis is a lesion of the spinal marrow, which causes the atrophy of muscles and nerves. 2. The seat of this lesion is the anterior part of the gray substance of the medulla, where softened portions of spinal substance are seen. 3. This softening is of an inflammatory nature—in fact, a simple myelitis. 4. Infantile paralysis should therefore be called spinal paralysis of children, and be classed among the affections of the spinal marrow, as depending on myelitis."

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[1] *Jahrbuch für Kinderh.*, 1873.

[2] *N. Y. Med. Record*, January 15, 1874.

[3] *N. Y. Obst. Jour.*, for May, 1874.

The views of Roger and Damaschino, expressed above, seem to harmonize more closely with, and to afford a more satisfactory explanation of, the symptoms, history, and lesions thus far observed in ordinary or typical cases than does any other theory. Many neuropathists regard suddenly-occurring active congestion of the anterior cornua as the cause of infantile paralysis; but there is that affinity between active congestion and inflammation that they may be regarded as having the same pathological effect in this instance, and therefore the two theories of a spinal congestion and spinal inflammation may be considered as one. It is not improbable that in some of the cases which more speedily recover there is simple congestion; while in the more obstinate cases and those with inflammatory symptoms the congestion has passed into an inflammation or inflammation was present from the first. According to this theory, the atrophy so generally observed in the twelve cases in which autopsies were made must be considered a degenerative change resulting from the inflammation. That so accurate an observer and so excellent a microscopist as Robin could detect nothing abnormal in the case which he examined was probably due to the fact that the inflammation or congestion abated without producing any degenerative changes in the nervous substance.

Professor Charcot regards atrophy of the motor-cells as the cause of the paralysis, but it is much more in consonance with the facts to consider the cellular atrophy a result than a cause. For how could atrophy, which always occurs gradually and by progressive increase, be the cause of a disease which begins abruptly and is most intense in the very commencement? Besides, atrophy does not occur without some antecedent disease to cause it.

In a report to the International Congress at Amsterdam, Drs. Damaschino and Roger give the following summary of the result of their recent study of the pathology of infantile paralysis:[2]

1. The anatomical lesions are situated in the motor regions of the spinal cord.

2. They consist of a central myelitis, with a stadium of softening and atrophic destruction of the cells of the gray substance, together with sclerosis of the lateral columns and considerable atrophy of the anterior roots and the nerves leading to the paralyzed muscles.

3. Atrophy of the cells is not—as Charcot is of opinion—the whole process, as it is in progressive muscular atrophy.

4. The opinion of Leyden, that there is a circumscribed and diffused myelitis in children, is worthy of consideration.

It remains for future examination to decide whether the myelitis begins as interstitial or parenchymatous in the connective tissue or the nerve-cells.

Recent observations by Drummond (1885), Gowers (1888), and others have apparently established the theory of Roger and Damaschino—to wit, that the paralysis which we are considering results from acute inflammation of the gray matter of the spinal cord, and entirely or chiefly of the gray matter in the anterior cornua, that of the posterior cornua not being affected.

[1] *Gaz. méd. de Paris*, 1871.

[2] *Le Progrès médical*, No. 39, 1880.

All muscular fibres which are in a state of disuse begin in a few weeks to atrophy and undergo fatty degeneration. The transverse striæ in the primitive muscular fasciculus gradually disappear, and are replaced by granules of fat, and later still by small oil-globules. If we examine with the microscope the fibres from a muscle which has been a considerable time paralyzed, but which has still some electric contractility, we will find in places the striæ remaining, but numerous opaque granules of a fatty nature within the sarcolemma wherever the striæ are absent, and in other places, where the degeneration is most advanced, oil-globules occur, always small. If the paralysis be more profound, the striæ have all disappeared. At a later stage, usually after some years in cases of complete and incurable paralysis, the fatty matter may be to a considerable extent absorbed, and the fibrous network of the muscle which remains presents a tendinous appearance. There is a great difference, however, in different cases as regards the rapidity with which these changes occur. Hammond states that he found the striæ remaining in two cases after the lapse of more than four years of decided paralysis. The nerves of the paralyzed part also undergo atrophy.

Diagnosis.—This is easy as soon as the attention of the physician is directed to the state of the limbs. In a large proportion of cases the mother or nurse first observes the paralysis and calls the attention of the physician to it. A knowledge and recollection of the facts in relation to this paralysis should lead the physician to examine the state of the limbs in all cases of fever in young children occurring without apparent cause.

Prognosis.—It may be confidently predicted, if the child be seen early and correctly treated, that the paralysis will diminish, if it cannot be entirely cured. If the paralysis have continued a considerable time, and there be no electric contractility of the muscles, there is poor prospect of any improvement. The induced current will fail sometimes to cause muscular contraction, when the direct current may produce it; but if there be no response to the direct current, there is no therapeutic agent which can restore the use of the limb.

In cases seen soon after the paralysis commences and before the stage of atrophy the prognosis is most favorable when there is still slight voluntary motion, and improvement commences early. In most instances, even when the paralysis has been mild and of comparatively short duration, the extremity, although its motion be fully restored, is for a long time weaker than before the attack.

Treatment.—A physician called at the commencement of the paralysis should endeavor to remove every cause which might increase the irritability of the nervous system. The bowels should be kept open and the diet be plain and unirritating.

Local treatment is very useful at all periods of the paralysis. In the first days cold applications, as by an India-rubber bag containing ice, should be made over the spine. Stimulating embrocations over the spine and upon the paralyzed limb are appropriate after the cold has been discontinued, and benefit may also be derived from dry cups along the spine. Ergot, the bromide and iodide of potassium, which may be administered variously combined or singly, are the appropriate remedies for the first twelve or fourteen days. Administered every three or four hours in proper dose, they are the most effectual of all internal remedies for diminishing spinal congestion and preventing effusion and permanent structural change in the cord. Unfortunately, this first stage is in many instances far advanced before proper treatment is employed to subdue the myelitis, either from an incorrect diagnosis or because the physician is not summoned until structural changes have occurred, which constitute the second stage.

If the paralysis continue or if it do not progressively diminish, we should not delay more than two weeks from the commencement of the disease before employing appropriate measures to restore the use of the limbs and arrest atrophy of the muscles. The expectant plan of treatment, which is proper in many diseases of children, is unsuited to this. Muscular atrophy may commence in three weeks, and the farther it has advanced the more difficult and tedious will be the cure. Therefore, by the close of the second week, if the paralysis continue or be not rapidly disappearing, iron as a tonic with strychnia should be prescribed. There is probably no better formula for the exhibition of these agents than the following from Professor Hammond:

℞.	Strych. sulphat.,	gr. j;	
	Ferri pyrophosphat.,	ʒss;	
	Acidi phosphorici dilut.,	ʒss;	
	Syr. zingib.,	℥iijss.	Misce.

One-third of a teaspoonful or one-ninetieth of a grain of strychnia is sufficient for a child of two years, administered three times daily. Hillier, Barwell, and others have employed subcutaneous injections of strychnia, with, it is stated, a good result. While in the first and second weeks the child has been allowed to remain quiet, he should now be encouraged to use his limbs. Frequent muscular contraction must, if possible, be produced, and the voluntary movements, when not totally lost, aid greatly in promoting the nutrition of the muscles and restoring their function. Immersing the limb for half an hour in water at a temperature of 110° or 115°, rubbing the limb with a coarse towel, and kneading the muscles aid also in restoring nutrition and tone to them.

But, fortunately, we have an invaluable agent in the electric fluid, which can be made to penetrate the muscles and cause their contraction when every other measure has failed. The induced current should be employed upon the limb every day or second day if it cause the muscles to act, but if the loss of power be of long standing or complete, so that the induced current is not sufficiently powerful, the direct current should be used instead. It is not regarded as important which way the current passes, provided that the muscles contract.

In a large proportion of cases a cure cannot be effected until the lapse of several months, so that the patience of the physician and friends may be put to the test; but if muscular atrophy can be prevented and the limb kept at nearly the normal temperature, this mode of treatment will ordinarily in the end be successful. The primary affection which caused the paralysis will, with some exceptions, be removed by the treatment indicated above, after which the state of the muscles and their nervous supply demand the whole attention. Observations show that by treatment perseveringly employed fatty degeneration of the muscular fibres can be not only arrested, but the fat which has already been deposited within the sarcolemma may be absorbed and the muscular striæ restored. In those cases in which it has been necessary to employ the direct current the induced should be used whenever by the improvement of the case it is found sufficiently powerful.

CHAPTER XVII.

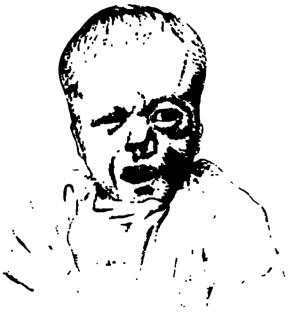
FACIAL PARALYSIS.

CAUSES.—Facial paralysis in the new-born commonly occurs from pressure of the blade of the forceps upon the portio dura at a point external to the stylo-mastoid foramen. It may also occur in children of any age from exposure of the face to a cold wind. The pressure of a tumor upon some part of the portio dura, or even of the fist of the child placed under the face during sleep, may cause it. It may also result from disease of the temporal bone, producing pressure on the nerve, as caries, periostitis, suppuration, or hemorrhage into the aquæductus Fallopii, and also from intracranial disease affecting the pons Varolii or the medulla oblongata.

SYMPTOMS.—The portio dura, which is a nerve of motion, supplies the muscles of the face, and therefore its loss of function is at once manifest in distortion of the features. The eye of the affected side remains open in consequence of paralysis of the orbicularis palpebrarum, the upper lid being raised by the levator muscle, which is not paralyzed, since its nerve is derived from the third pair. From the inability to wink, the eye becomes irritated by dust and constant exposure, and in children old enough to have an abundant lachrymal secretion the tears are liable to flow over the cheek. On account of the paralyzed and relaxed state of the facial muscles the mouth is drawn toward the healthy side, while the affected side presents a swollen appearance. Movement of the eyebrow of the anterior portion of the scalp on the paralyzed side is also impossible, since the occipito-frontalis and corrugator supercilii are supplied by the portio dura. If the cause of the disease is located above the origin of the chorda tympani, the flow of saliva and sense of taste on the affected side are impaired. If the injury be posterior to the gangliform enlargement, those symptoms are superadded which are due to paralysis of the petrosal nerves.

The accompanying woodcut represents a case which was under observation in the New York Infant Asylum. Its age at admission was about five months, and its previous history was unknown. The paralysis was permanent. Death occurred some months later from an intercurrent disease, and no cause of the paralysis could be discovered in a careful examination.

FIG. 39.



PROGNOSIS.—This depends on the cause. If the cause be peripheral, as from the pressure of the forceps or from cold, the prognosis is favorable. In case of deep-seated lesion, unless syphilitic, the prognosis is usually unfavorable. A syphilitic lesion can often be removed by appropriate remedies and the paralysis be cured.

TREATMENT.—In paralysis of the new-born from pressure of the forceps all that is required is occasional rubbing or gentle kneading over the affected muscles. In those who are older the nature of the cause, so far as ascertained, must determine the treatment. If there be glandular swellings and discharge from the ear from scrofula, cod-liver oil and the syrup of the iodide of iron are required internally, with appropriate external treatment of the glands and ear. If syphilis be the cause, mercurials and the iodide of potassium should be employed. If the patient do not soon begin to improve, the treatment recommended for infantile paralysis, modified somewhat on account of the difference in location, is appropriate. Iron and strychnia may be administered internally. The external treatment should consist of friction, kneading, hot applications, and the electric current. The current should have only moderate intensity, for a high degree of it might injure vision. It should be applied every second day, with one pole over the mastoid foramen and the other moved slowly over the muscles.

CHAPTER XVIII.

PSEUDO-HYPERTROPHIC PARALYSIS.

THIS is a rare disease. It was first described by Duchenne in 1861, and since the attention of the profession was directed to it cases have been observed on the Continent, in Great Britain, and in this country. Though our acqaintance with it is so recent, it has been fully and accurately described by various writers in our language. The *Transactions of the London Pathological Society* for 1868 contain a translated paper relating to it, communicated by M. Duchenne, with photographic views and remarks by Lockhart Clarke, and also the histories of two cases occurring in London and exhibited to the Society by Adams and Hillier. In this country an elaborate paper has appeared on this form of paralysis from the pen of Dr. Webber[1] of Boston, who succeeded in collecting the records of 41 cases; and more recently Dr. Poore,[2] physician to the New York Charity Hospital, collated the records of 85 cases, which furnish the material of his monograph.

Weakness of the legs and a peculiar waddling gait are the first observable symptoms, and by them we are able to ascertain approximately the date of the commencement of the paralysis. In 27 of the cases collated by Dr. Poore the malady began so early in infancy that they were never able to walk like other children; in 5 there is no record in regard to the time when the peculiar gait was first observed or whether they ever could walk; 52, or about two-thirds of the cases, walked well at first, having no symptoms of the paralysis till after the age of two years. In 15 of these weakness of the legs and the peculiar gait were first observed between the ages of two and a half and five years; in 23 between the ages of five and ten years; in 6 between the ages of ten and sixteen years; and in 8 over the age of sixteen years. It is seen, therefore, that this malady is pre-eminently one of infancy and childhood.

The gait, which is unsteady and waddling, has been compared to that of a duck. The child stands with the legs wide apart, and from the weakness of the legs and unsteadiness of the gait frequently stumbles and falls. In many cases this muscular weakness and difficulty in walking occur before there is any perceptible enlargement of the muscles beyond the normal size.

The hypertrophy occurs without tenderness, pain, or other nervous symp-

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[1] *Boston Med. and Surg. Jour.*, Nov., 17, 1870.

[2] *New York Medical Journal*, for June, 1875.

[illegible] and therefore [illegible] greater than else[illegible] the patient is [illegible] the unequal [illegible] that the [illegible] the [illegible] of the [illegible]

[illegible] contractility of the muscle [illegible] response to the galvanic current [illegible] to the degree of atrophy of the [illegible] normal sensibility, with exceptional [illegible] either general or in places. Reddish [illegible] of the extremities is sometimes observed [illegible] obstructed venous circulation in the hypertrophied [illegible] by others is supposed to be due to the peculiar [illegible] pathic state. The bladder and rectum are not involved. The mental faculties are more or less blunted and feeble in certain cases, especially when the disease begins in early infancy, but in some patients they do not seem to be materially impaired.

Anatomical Characters.—There have been so few post-mortem examinations of those who died having this disease that it is still uncertain whether there is any centric lesion. Cohnheim examined the spinal cord in one case, and could find nothing abnormal. Recently, Mr. Kesteven has examined the brain and spinal cord from a case, and found dilatation of the perivascular canals both in the brain and spinal cord, and also spots of granular degeneration, chiefly in the white substance, "caused by loss of cerebral tissue replaced by morbid matter."[1] As this child was imbecile, it is not improbable that these lesions were connected with the mental state and not the muscular disease.

Professor Charcot[2] reports a careful miscroscopic examination of the spinal cord and of the nerves in a case which had continued ten years. He could discover no deviation from the healthy state. More recently Dr. J. Lockhart Clarke[3] examined a case and found the encephalon healthy, but in the spinal cord there was more or less disintegration of the gray substance in each lateral half, and in places dilatation of vessels and commencing sclerosis.

It seems, therefore, that central lesions are not essential and are sometimes absent. When they do occur it is probable that they are consecutive to the paralysis.

The essential lesions in this malady are atrophy of muscular fibres and hyperplasia of the connective tissue which surrounds these fibres. The hyperplasia of the one element in the muscle is greater than the atrophy of the other, and hence the increase of volume above the normal size. The atrophy is probably a primary lesion, for muscular weakness ordinarily occurs for a considerable time before there is any evidence of the enlargement, and, as we have seen, certain muscles may undergo the atrophy without the hyperplasia. Still, the mechanical effect of the newly-formed connective tissue doubtless increases the atrophy in those muscular fibres which this tissue surrounds, and the comparatively quiet state of muscles in consequence of paralysis not only tends to promote the atrophy and degeneration of these muscles, but also of contiguous healthy muscles.

The muscles which are involved in this paralysis present a pale yellowish hue, resembling, says Niemeyer, the appearance of lipoma. Examining by the microscope, we find, in addition to a large increase in the fibrous tissue and atrophy, and in some places disappearance of the muscular element, more or less fatty matter, granular and globular, occupying the interstices. Mr. Kesteven describes as follows the appearance of the muscles in the case which he examined: "The muscular substance is pale, almost white, and very greasy. The superabundance of fat is evident to the naked eye. The muscular fibres present the ordinary striation, but less distinctly than usual. The ultimate fibres are pale, and separated by a large increase of areolar and fibrous tissue."

Causes.—Why there is this strange perversion of nutrition, so that there is an exaggerated development of the connective tissue of the muscles and atrophy of the muscular fibres, is unknown. Boys are more liable to be affected than girls. Of the 85 cases embraced in the statistics of Dr. Poore, 73 were boys, and there was a similar excess of males in the cases collated by Dr. Webber.

There is in a considerable proportion of cases the record of hereditary transmission, and in almost all the instances the predisposition is acquired from the mother's side. Thus in 37 of Dr. Poore's cases "2 or more belonged to the same family." In some instances three and even four maternal relatives had this form of paralysis. In one case observed by Duchenne, and in a few others subsequently observed, this malady seemed to be congenital, for the limbs at birth were unusually large, and the patients when they came under observation were unable to walk. No relation has been observed between this paralysis and syphilis, scrofula, or other diathetic diseases.

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[1] *Jour. of Med. Sci.*, Jan., 1871.

[2] *Archiv. de Physiol.*, March, 1872.

[3] *Medico-Chir. Trans.*, 1874.

Prognosis.—This disease is in most instances progressive, terminating fatally after a variable period. It is in its nature chronic, rarely ending in less than five or six years. A considerable proportion live longer, some even attaining adult age. The paralysis may be stationary for a time, but afterward continue to increase. Duchenne has reported one case of recovery. In two or three other instances patients appeared to improve somewhat under treatment, but the writers admit they may have become worse afterward. Death usually occurs, not directly from the paralysis, but from some intercurrent disease, especially of the lungs.

Treatment.—The treatment thus far employed has been chiefly local, consisting in the use of electricity and kneading or shampooing over the affected muscles. Both the primary and induced electric currents have been employed, but, unfortunately, without any appreciable benefit in most cases. Benedikt, who claims a better result from electrization than any other observer, applied the copper pole over the lower cervical ganglion, and the zinc pole along the side of the lumbar vertebræ by means of a broad metallic plate.

CHAPTER XIX.

DISEASES OF THE SPINAL CORD AND ITS COVERINGS.

The diseases of the spinal cord and of the parts which cover and protect it are important, but they are less understood than are those of any other portion of the body. This is partly due to the fact that in many cases the spinal disease coexists with a similar pathological state of the brain or its meninges, the symptoms of which predominate and mask those which pertain to the spine; partly to the fact that the chief symptoms of spinal disease are often located in organs or parts which are at a distance from the spine; and, lastly, to the fact that it is difficult, for obvious reasons, to determine the exact state of the spine at the bedside, while post-mortem inspection of the spine, which alone can give accurate pathological knowledge, is less frequently made than of any other organ.

Certain spinal diseases occurring in childhood are the same as in adult life, presenting identical symptoms and lesions in the two periods, and therefore they require no extended notice in this treatise. Others are common to childhood and maturity, but they present peculiarities in the former period which require to be pointed out, while others still are peculiar to childhood.

The so-called spinal irritation or anæmic neuralgia is not infrequent in delicate and poorly-fed children. I have from time to time observed marked cases of it in the class in the Out-door Department of Bellevue, the patients
usually being above the age of three or four years and exhibiting ev
of cachexia. Most of them have been spare and pallid, some af
a nervous cough or palpitation, and some with neuralgic pains
abdomen, or elsewhere, which pressure at a certain point

intensified. These cases recover by better feeding, outdoor exercise, mild counter-irritation along the spine, and the use of tonics, especially of iron.

Primary inflammation of the cord and its meninges is rare in children. Secondary inflammation of these parts is, on the other hand, more common in children than in adults. It is common in caries of the vertebræ and in cerebro-spinal fever. The preponderance in functional activity of the spinal cord and the feeble controlling power of the brain render infancy and childhood more liable to convulsions and reflex paralysis than any other period in life. Cases of true reflex paralysis occasionally occur in children, in regard to the etiology of which there can be no doubt. Prof. Sayre of this city has called attention to the fact that balanitis and preputial adhesions sometimes cause paraplegia, more or less pronounced, in young children, and which is relieved by dividing the adhesions and restoring the mucous surface of the glans and prepuce to its normal state. Such a case was brought to the children's class in the Out-door Department at Bellevue in April, 1875. The child could not walk or scarcely stand without support, but after the division of the adhesions and subsidence of the inflammation locomotion rapidly improved.[1] In another instance a child could not walk properly, having a tottering gait and dragging one foot. The preputial and urethral orifices presented an irritated appearance. The prepuce was stretched and separated from the glans at a few sittings, the instrument used being an infant's catheter stiffened with a wire, so that it served as a probe. Large masses of smegma, nearly as far forward as the preputial orifice, were found underneath. These were removed, and the parts were smeared with sweet oil. The patient rapidly recovered the full use of his limbs, and was soon entirely well. It is well known that masturbation sometimes causes a similar weakness of the lower extremities. Dr. West relates the case of a child "between two and three years old" who began to totter in his gait, and finally almost ceased walking. He was observed to practise masturbation. "This was put a stop to," and he soon recovered his health and his power of locomotion.[2]

CHAPTER XX.

CONGESTION OF THE SPINAL CORD AND ITS MEMBRANE.

CONGESTION of the spinal cord and meninges occurs both as a primary and secondary malady, the latter being more frequent than the former. It may be active or passive. Active congestion, occurring independently of meningitis or myelitis, is in most instances transient and subordinate to some graver disease, in the course of which it arises. It is probably often overlooked. It is not fatal, and its symptoms are frequently masked by those which are referable to the brain or some other organ. It is believed to be common in the initial period of certain of the fevers of childhood. It is not improbable that the hyperæsthesia observed upon the thoracic and abdominal surfaces and along the thighs in the commencement of remittent and certain other febrile diseases has its origin in a congested state of the spine. To this congestion writers attribute the lumbar pain and occasional paraplepia in the initial stage of variola. Active spinal congestion may also result from the sudden impression of cold, and, as we have stated above, this is apparently the most frequent cause of poliomyelitis acuta anterior.

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[1] Drs. Holgate and Bosley, formerly attending physicians in the children's class at Bellevue, made many examinations of the state of the prepuce in young children. They report that they found preputial adhesions almost daily, in most instances without symptoms, but sometimes with dysuria, and occasionally with more or less impairment of the use of the legs.

[2] *Diseases of Children*, page 146, 4th Amer. ed.

Certain anatomical circumstances favor the occurrence of passive congestion of the spinal cord and meninges—to wit, the tortuousness of their veins and the absence of valves in these veins, the lack of muscular support of the vessels, and the inferior position of the spine in sickness as the patient lies quietly in bed. A common cause of passive congestion of these parts is some protracted and enfeebling disease which diminishes the contractile force of the heart (cardiac paresis), producing congestion of the spinal cord in the same manner as under similar circumstances hypostatic congestion of the lungs occurs. Severe convulsive diseases, as tetanus or eclampsia, when protracted or occurring at short intervals commonly produce spinal congestion. In tetanus this congestion is extreme, so that extravasation of blood is liable to occur from the engorged vessels, especially those of the pia mater.

Anatomical Characters.—It is often impossible, at post-mortem examinations, to determine how much of the congestion of the spine and its meninges is pathological and how much cadaveric, since, if the corpse be placed on its back at death, a very considerable engorgement of the spinal vessels occurs from gravitation of blood. If the body have been placed on the side or face, this cadaveric congestion is prevented. Since in active congestion the arterioles and capillaries are distended with arterial blood, the color is a brighter red than in passive congestion, in which venous blood predominates. *Active* congestion of the cord usually coexists with that of the meninges, but it may occur without it. In cases of considerable congestion the "puncta vasculosa" appear upon the incised surface both of the white and gray substance. If the congestion be protracted or if it recur frequently, it may produce permanent dilatation of the arterioles and capillaries in greater or less degree, and it may also lead to sclerosis of the cord. *Passive* congestion seldom, perhaps never, occurs in the cord without being equally and often to a greater extent present in the meninges. Continuing for a time, it gives rise to transudation of serum into the interspaces over the cord, and even softening of the cord may occur to a limited extent from imbibition of serum. In either form of congestion extravasations of blood are frequent.

Symptoms.—Spinal congestion is announced by pain in the region of the spine, usually in the lumbar or dorsal and lumbar portions, and irradiations of pain and tingling in the legs. In addition, more or less paralysis of the bladder and legs may result. The paraplegia may occur early or not till the lapse of several days. In active congestion the symptoms are rapidly developed, and they attain their maximum intensity sooner than in the passive form. In passive congestion the development of symptoms is not only more gradual, but they are ordinarily less pronounced, and are attended by more fluctuation, than in the active form. The paralysis, if present, comes on slowly after several days, and is incomplete. Spinal congestion, especially of the passive form, is sometimes associated with cerebral congestion—as, for example, in tetanus and severe eclampsia—and the spinal symptoms therefore coexist with those which have a cerebral origin. The duration and the result of a hyperæmic state of the spinal cord and its meninges depend largely on the nature of the cause. If it be not relieved within a few days, there is strong probability that some other serious pathological state has supervened, as meningitis, myelitis, extravasation of blood, or serous transudation, with softening of the nervous substance.

Treatment.—In the adult spinal congestion sometimes results from the sudden cessation of the hemorrhoidal or catamenial flow, and the application of leeches or wet cups along the spine is indicated. But in the child the abstraction of blood is seldom required. In the acute stage of active spinal congestion, with elevation of temperature, cold applications along the spine are often beneficial, as by an India-rubber bag.

In active hyperæmia laxatives are useful, and rubefacient applications should be made along the spine, as by mustard or by friction with a stimulating liniment. In the inflammatory spinal congestion of cerebro-spinal fever I have employed with a very satisfactory result a liniment containing equal parts of camphorated oil and turpentine. In both active and passive hyperæmia lateral decubitus should be prescribed rather than dorsal. The use of ergot in order to diminish the turgescence of the vessels of the spinal cord and meninges has been advocated by Brown-Séquard, and it is now one of the recognized remedies. Bromide of potassium is also a remedy of value, but it is more useful in some cases than in others. It is signally beneficial in those cases in which there is also cerebral congestion. When the congestion is increased or produced by clonic convulsions the bromide is one of the most reliable remedies which we possess for the removal of the cause. Thus, it should be employed in the treatment of the spinal and cerebral congestion in the commencement of variola, in which convulsions are so common, and in the convulsions of pertussis or pneumonia, which cause extreme passive congestion of the cerebro-spinal axis. Passive congestion of the spine, common in exhausting diseases and due to feebleness of the circulation, is best treated by stimulating and sustaining remedies and by the lateral decubitus. It is hypostatic, and may be associated with a similar congestion in the posterior part of the lungs.

CHAPTER XXI.

VERTEBRAL CARIES.

Vertebral caries, designated also Pott's disease, occurs chiefly in childhood, but now and then adults are affected with it. It is an osteitis of the bodies of one or more vertebræ, ending in their ulceration and a lifelong deformity if not checked.

Causes.—A reduced state of system, and especially the scrofulous diathesis, strongly predispose to caries. Hence this malady is more common in the city than in the country, where better hygienic conditions produce a more vigorous constitution. Prolonged antihygienic conditions and protracted ill-health from whatever cause predispose to caries. In certain cases there is no apparent exciting cause, while in others there is the history of a fall upon or some injury of the spine.

Vertebral caries may occur in the cervical, dorsal, or lumbar portions of the spinal column, but it is more common in the lower dorsal than elsewhere. With the development of the osteitis the body of the vertebra which is affected becomes hyperæmic, and the spongy tissue is soon infiltrated with blood and pus. The bone becomes swollen and softened, and therefore less resisting than in the healthy state, so that it yields under the weight of the shoulders and head, which it sustains. Therefore, after the osteitis has continued a certain time there begins to be posterior convexity, or rather angularity, of the spine, for while the vertebral bodies soften and yield by the weight above them, the arches retain their integrity and firmness and are unyielding.

Much of the tediousness and suffering of this malady is due to the fact that the inflammation is so deep-seated and a healthy bony barrier is interposed between it and the surface, so that there is no ready escape of the pus. It permeates the spongy tissue, filling the cavities produced by the softening and absorption of the bone-substance. If the inflammation be of small extent, the amount of pus small, the constitution good, and if the disease be early recognized and properly treated, the child may recover without any fistulous opening by absorption of the pus, and with little remaining deformity.

In the large proportion of cases, however, the history is different. The disease is not recognized till the stage of deformity, the caries, is so extensive and the pus so abundant that it escapes between the vertebræ, forming an abscess external to them which connects with the interior of the vertebræ by a fistulous canal. This abscess, if in the cervical region, may press upon the pharynx or œsophagus or upon the air-passages, producing dangerous obstruction to respiration. This disease will be treated of hereafter. The pus may point and discharge externally near the seat of the caries, but in a large proportion of instances it takes a long and circuitous route to the surface or it opens internally. There are instances in which it discharges into the pleural or abdominal cavity or into one of the abdominal organs. If, as is sometimes the case, it establishes a connection with the intestine and escape in the stools, the result will probably be favorable. In other instances it descends into the pelvic cavity and finds an outlet by the inguinal ring or sciatic notch, or it enters the sheath of the iliacus or psoas muscle and points externally.

When the disease ends favorably new bone is thrown out around the diseased vertebræ, preventing further bending and giving stability to the spine. If the abscess do not discharge, but remain subcutaneous, Billroth says: . . . . "While the bone disease recovers most frequently, a large part of the pus, whose cells disintegrate into fine molecules, is absorbed, while the inner walls of the abscess change to a cicatricial tissue which in the shape of a fibrous sac contains the puriform fluid. Such pus-sacs often remain in this stage for years."

If the pus have escaped externally, the abscesses and fistulæ contract and finally close, their site being occupied by condensed connective tissue. The portions of the diseased vertebræ which have retained their vitality are enveloped and supported by the new bone, so that the part of the spine which was the seat of the disease, though ankylosed and curved, has greater firmness than in health.

The history of unfavorable cases varies. The caries may extend; pus, finding no vent, may accumulate in cavities and sinuses in which detached portions of bone float, or it may make its way in such directions that it produces alarming complications and impairs or obstructs the functions of important organs.

Spinal meningitis in the vicinity of the caries, and due to extension of the inflammation, is common, and "the spinal medulla," says Billroth, "may be endangered by participation in the suppuration or by being so bent by the inclination of the vertebræ that its function is destroyed." Hence the paralysis of the lower extremities, bladder, and rectum which occurs in aggravated cases and which entails a fatal issue. In a certain proportion of cases the blood becomes more and more impoverished from the continuance of the inflammation and suppuration, and death occurs in a state of exhaustion. In such cases post-mortem examination often discloses waxy degeneration of important organs, as the spleen, liver, kidneys, and intestines, for it is well known that chronic suppurative inflammation of the bones is one of the two chief causes of the waxy disease, syphilis being the other.

SYMPTOMS.—Caries of the vertebræ is often preceded by symptoms or appearances which are due to the strumous cachexia. Strumous ailments have probably occurred in the patient or in members of the family, or without any clear history of struma the child has perhaps for some time been in failing health. In cases which I have observed one of the chief symptoms, and sometimes almost the only symptom in the commencement of the caries, has been neuralgic pain, usually not severe, intermittent, or more or less constant, at some point in the anterior aspect of the body, most frequently in the chest, epigastric or umbilical region. This pain has been present in a larger proportion of cases than pain in the spinal region at the seat of the caries, though Guersant dwells particularly upon the latter as a symptom of caries. Patients with this neuralgia are not infrequently treated for indigestion or worms, the true nature of the malady not being suspected and the spine not even being examined. This neuralgia seems to be due to compression of the spinal nerves by inflammatory exudation at the points where they emerge from the spinal canal. I can recall to mind a number of cases in which I have on different occasions been asked to prescribe for this neuralgia, which was shown by the sequel to be undoubtedly the result of vertebral caries, and yet with a careful examination of the spinal column I could discover no evidences of disease at any point. After a time, tenderness, pain, and inflammatory induration, appreciable to the touch, may occur in or along the spine, but not usually till the malady is well advanced. Lassitude, fatigue after slight exertion, poor appetite, with slight fever, are common symptoms in the first stage of the caries.

As the case advances, if the nature of the disease be not recognized and no artificial support of the trunk be provided, the child instinctively seeks some way of supporting the head and shoulders. He rests his head upon his hands or his elbows upon the table. Soon a gibbosity or angularity appears, affording clear and positive proof of the nature of the disease. Even now there is little or no tenderness when pressure is made directly on the spine, but it is observed more when pressure is made laterally upon it. If the inflammation extend so as to involve the meninges and the cord, pricking, tingling, numbness, or weakness of the legs may occur, which are symptoms of grave import, for it is probable that the case will end in paraplegia and death. A state of emaciation and general weakness, sometimes accompanied by diarrhœa and œdema of the limbs, precedes death. But a very considerable degree of curvature is not incompatible with a healthy and normal performance of all the functions, and the number who recover and live to an advanced age with deformity is large, as every one knows.

DIAGNOSIS.—This is often, from the nature of the disease, obscure and uncertain for a time. The long continuance of pain in the chest or abdomen, or perhaps in the thighs, without any cause which we can detect located at the seat of the pain, should excite suspicion of spinal disease. Such pain may be produced by spinal irritation, but in this malady pressure on the spine is badly tolerated, and when we touch a certain part the neuralgic pain is intensified. In caries, as we have seen, firm pressure upon the spine is tolerated, and it does not increase the neuralgia. At a later period in caries there may be spinal pain and tenderness, but there is now also spinal deformity, by which alone the diagnosis is clearly established; stiffness observed in the movements of the spine, pain in the spine on sudden movement or jarring the body, impaired appetite and general health, and instinctive desire to sit or recline in such a way as to relieve the spine partially of the weight of the head and shoulders, are symptoms which, if they coexist, afford very strong evidence of the presence of caries, although there be as yet no deformity.

The spinal deformity of rachitis is distinguished from that of caries by the fact that it occurs slowly without pain or tenderness and is rounded instead of angular. Moreover, the rachitic diathesis precludes scrofulous ailments, and the scrofulous diathesis rachitic ailments, as the two diatheses do not coexist or but rarely; so that if there be in the state of the patient or have been in his history evidences of scrofula, the presumption is that the bending of the spine occurs from caries. In a case of rachitic curvature we find also enlargements of the ankles and wrists, keel-shaped thorax, prominent abdomen, rachitic head, etc.

Prognosis.—The course of this malady, even when the caries is slight and the symptoms mild, is tedious. In the most favorable cases the general health is but slightly impaired, the caries is confined to one vertebra, and is early diagnosticated and properly treated. On the other hand, if the general health be decidedly poor, the child anæmic and wasted, the curvature great, and an abscess have occurred, the case is very serious. Between these two extremes is every grade. The prognosis is more favorable in the child than in the adult. The few adults whom I have seen with it all died. It is less favorable in the cervical region than in the dorsal or lumbar. A mild case occurring in a good condition of health may become grave, and even fatal, by neglect and improper treatment. A majority of the patients, if the disease be not too far advanced when recognized, recover if properly treated, but the deformity which results may prove serious in after-life. The incomplete expansion of the lungs in the humpbacked greatly increases the dyspnœa and the danger in subsequent years if bronchitis or pneumonia occur, and if the caries have been at a low point in the spine and the patient a female, the deformity will probably present an obstacle to childbearing.

Treatment.—The treatment must be constitutional and local, hygienic, medical, and mechanical. It is of the utmost importance to improve the general health, as it is in all chronic inflammations and scrofulous ailments. Pure air, sunlight, personal cleanliness, and plain but the most nutritious diet are required. Tonic and antistrumous remedies are indicated. To many patients I have prescribed, three times daily, cod-liver oil to which the syrup of the iodide of iron was added, giving two or three drops of the latter to a child of one year and one additional drop for each additional year. The judicious use of alcoholic stimulants will often be found useful if the appetite be poor and the general health seriously impaired, as will also the vegetable bitters.

In all strumous inflammations of the bones which extend to or involve joints, and which are in their nature chronic, perfect quiet of the parts, so far as is consistent with the degree of exercise which is required in order to improve the appetite and general health, is indispensable for successful treatment of the case. The patient with this malady should be encouraged to lie much of the time in bed, for the double purpose of preventing movements of the inflamed vertebræ and relieving them of the weight of the shoulders and head. But confinement in bed is badly tolerated, and exercise is necessary for a healthy functional activity of the organs; therefore mechanical support of the spine is required. The apparatuses which have been invented for the purpose of supporting the spine and rendering it immovable, and of sustaining the head if the caries be in the cervical region, or the head and shoulders if it be in the dorsal or lumbar region, are ingenious and effectual. Some of them are rather cumbersome, but others are sufficiently light for the youngest child who can walk. The apparatus should be worn for months, care being taken to prevent excoriation or undue pressure upon any point. It may be removed at night and reapplied on rising in the morning.

SECTION II.

DISEASES OF THE RESPIRATORY SYSTEM.

CHAPTER I.

CORYZA.

THE term "coryza" is applied to inflammation of the Schneiderian membrane. It is acute or chronic. The acute form is primary or secondary. Acute primary coryza is common in infancy and childhood. Its usual cause is exposure to currents of air, to cold, and especially to sudden changes of temperature from warm to cold. The cause is the same as that in the ordinary forms of bronchitis. The two diseases frequently indeed coexist, occurring from the same exposure. The inflammation in such cases commences upon the Schneiderian membrane immediately upon the operation of the cause, and soon after extends to the bronchial tubes. Acute coryza may also be produced by the inhalation of irritating vapors, hot air, or dust, and also by the presence of a foreign body, as a button or bean, in the nostril.

Secondary coryza is commonly due to a specific cause. The diseases in connection with which it occurs are whooping cough, measles, scarlet fever, diphtheria, and constitutional syphilis. In the infant coryza is one of the first manifestations of inherited syphilitic taint.

Acute primary coryza ordinarily abates in from one to two weeks. The secondary form gradually declines, in most cases, when the primary affection on which it depends is cured. Syphilitic coryza is more protracted than the primary form or than that accompanying the eruptive fevers. Some children are so liable to coryza that it occurs whenever they take cold. Occasionally it is so frequently renewed in the winter months that it resembles the chronic form of the disease.

Chronic coryza is commonly dependent on a dyscrasia, usually the syphilitic or strumous. The dyscrasia is indicated by pallor, flabbiness of the flesh, and liability to glandular swellings. Certain cases take their origin in the nasal catarrh of the exanthematic fevers, the local affection continuing after the constitutional disease has declined. Chronic coryza sometimes occurs in children who appear otherwise in good health. It is probable that in such cases there is a dyscrasia of which the coryza happens to be the sole manifestation.

ANATOMICAL CHARACTERS.—The alterations which the nasal mucous membrane undergoes when inflamed vary considerably in different cases. In the simplest and most common form of coryza this membrane is sometimes in patches, sometimes generally reddened, thickened, and softened. Its papillæ are prominent, producing an inequality of the surface. Ulcerations are not common in simple acute coryza, but they sometimes occur in the chronic form.

In diphtheria, and sometimes in scarlet fever and variola of severe type, the coryza is pseudo-membranous, and when it presents this form it is commonly but not always associated with pseudo-membranous angina or laryngitis. A case of pseudo-membranous coryza occurring in measles is related by M. Guibert. The patient was a rachitic boy three and a half years old. The pseudo-membrane in grave cases may cover almost the entire surface of the nostrils, but ordinarily it occurs in patches.

SYMPTOMS.—The constitutional symptoms are mild or severe, according to the gravity of the inflammation. If the coryza be acute and pretty general, there is febrile movement, with thirst and loss of appetite. Frontal headache is common, from the proximity of the inflammation to the head or its extension to the frontal sinuses. Sneezing is the first symptom in many cases of acute coryza. As the inflamed membrane swells more or less obstruction occurs to respiration. The breathing is noisy, especially during sleep, and in severe cases the patient is compelled to breathe mostly through the mouth. If there be much obstruction to respiration the suffering of the patient is considerable, from the sensation of fulness in the nostrils, the headache, and the muscular effort required in each respiratory act.

In the commencement of coryza the patient experiences a sensation of dryness in the nostrils, which is soon succeeded by a thin discharge of a serous appearance. In the course of a few hours the secretion becomes thicker. It is muco-purulent, and remains such till the disease begins to decline. Inspissated mucus and crusts are liable to collect within the nostrils and around their orifice in chronic coryza, and sometimes also in the acute disease if the discharge be not abundant. These crusts increase the difficulty of breathing. Often the acridity of the discharge is such that the skin of the upper lip and around the nostrils is excoriated.

PROGNOSIS.—Uncomplicated catarrhal coryza rarely terminates fatally. It is only dangerous in young nursing infants, in whom it may prevent proper traction of the nipples. Coryza accompanying the eruptive fevers, although it may increase the suffering, does not materially increase the danger. Syphilitic coryza subsides when the system is sufficiently affected by antisyphilitic remedies. Chronic coryza is sometimes very obstinate. It may continue for months or years, giving rise to a constant, but often not abundant, discharge.

TREATMENT.—Common mild attacks of coryza require little treatment. The bowels should be kept open, the feet soaked in mustard-water, and the body should be warmly clothed. Inunction of the nostrils is a popular remedy, and it seems to give some relief. If coryza commence with symptoms which indicate a pretty severe attack, and there are evidences of extension of the disease toward the bronchial tubes, an emetic of syrup of ipecacuanha, given at an early period, moderates the severity of the inflammation and may prevent the occurrence of bronchitis. Afterward a simple diaphoretic mixture, as the following, should be given:

℞. Syrupi ipecacuanha,	ʒij;	
Spirit. æther. nitr.,	ʒj;	
Syrupi simplicis,	℥ij.	Misce.

One teaspoonful every three hours to a child of six months.

In place of sweet spirits of nitre, acetate of potassium may be employed in the dose of one or two grains for infants; and if there be considerable fever half a grain or one grain, according to the age, of phenacetin or antipyrine may be given.

A 3 to 5 per cent. solution of common salt in warm water injected into the nostrils with a small syringe aids materially in removing the muco-pus which obstructs the respiration and in establishing a healthier state of the inflamed surface. The officinal lime-water is also a most useful detergent of the nasal surface. The following formulæ will be found useful in most cases of this form of coryza:

℞. Acidi borici,	ʒj;
Sodii biborat.,	ʒij;
Aquæ,	℥viij.

℞. Sodii chloridi,	ʒj;
Sodii biborat.,	ʒij;
Aquæ,	Oj. Misce.

Half a teaspoonful, used warm, should be injected into each nostril several times daily, with the head thrown backward.

The treatment proper for pseudo-membranous or diphtheritic coryza is detailed in our remarks on the therapeutics of diphtheria. Chronic coryza, since it depends upon a dyscrasia of which it is one of the local manifestations, requires remedies appropriate for the blood disease. Scrofula needs the syrup of the iodide of iron and cod-liver oil. The various ferruginous preparations, as wine of iron, tincture of the chloride of iron, iron lozenges, and the vegetable tonics are also more or less useful. The diet should be nutritious and plain, and outdoor exercise and, if possible, country life should be enjoined.

If the dyscrasia be syphilitic, similar invigorating measures are required, and mild mercurial inunctions to the nasal surface are especially useful. The following, which has been largely employed in the Out-door Department at Bellevue, is one of the best ointments for such cases, and its alterative effect renders it also useful for strumous coryza:

℞. Ung. hydrarg. nitratis,	ʒij;
Ung. zinci oxid.,	℥ij. Misce.

To be thoroughly applied to the Schneiderian membrane by a swab or camel's-hair pencil three or four times daily. Recently it has been modified by the substitution of Squibb's 5 per cent. oleate of mercury in place of the citrine ointment. If the coryza have a distinctly syphilitic origin, the application of a 2 or 3 per cent. oleate of mercury will fully meet the indication and be followed by improvement.

Meigs and Pepper recommend the following ointment in chronic coryza, to be applied at night after the use of injections through the day:

℞. Unguenti hydrargyri nitratis,	ʒss;
Extracti belladonnæ,	gr. x;
Axungiæ,	℥ss. Misce.

Astringent injections into the nostrils are not often required in the treatment of the various forms of coryza; but occasionally, if the discharge be protracted and abundant, weak astringent applications may be beneficial, as two or three grains of nitrate of silver or of alum or tannin to the ounce of water. It should be borne in mind that washes for the nasal surface should, as a rule, be employed tepid.

CHAPTER II.

LARYNGITIS.

CATARRHAL LARYNGITIS.

Acute catarrhal laryngitis occurs at all ages, but it is so common in infancy and childhood that it is proper to treat of it in a work relating to the diseases of these periods. Like other inflammatory affections of the air-passages, it is most common in the cold months or when the weather is changeable. Its usual cause is, therefore, exposure to cold. Protracted and violent crying and the inhalation of acrid vapors are occasional causes. Catarrhal—or, as it is sometimes designated, simple—laryngitis also occurs in connection with certain constitutional diseases, among which may be mentioned measles, scarlatina, and variola. Laryngitis is also a common accompaniment of bronchitis and broncho-pneumonia, though its symptoms are liable to be obscured by those of the graver disease. It often likewise accompanies pharyngitis, due to extension of the inflammation.

SYMPTOMS.—Catarrhal laryngitis produced by the impression of cold is commonly preceded by and accompanied by coryza. The initial symptom is chilliness, followed by sneezing and the discharge of thin mucus from the nostrils in consequence of irritation of the Schneiderian membrane.

The commencement of laryngitis is indicated by hoarseness, which is apparent when the child cries or, if old enough, when it attempts to speak. There is often in severe cases complete loss of voice, so that speech above a whisper is impossible. I have noticed this most frequently in the laryngitis which accompanies measles. A cough occurs which is at first dry and husky, but becomes loose in the course of a few days. Expectoration is scanty, unless the inflammation have extended to the trachea and bronchial tubes.

This disease is often accompanied by soreness of the throat, noticed in the act of coughing or when the larynx is pressed with the finger. In laryngeal catarrh, when uncomplicated, the respiration remains nearly natural and the pulse is but little accelerated. In mild cases the nature of the disease is often not apparent, as long as the child remains quiet, in consequence of the absence of symptoms, but the character of the voice when it cries or speaks, or of the cough, reveals at once the nature of the affection.

Acute laryngeal catarrh subsides in from one to two weeks. Occasionally it lasts three or four weeks before the symptoms entirely disappear. Death, which is rare, is due to some complication.

Chronic laryngitis is much less frequent than the acute form. Its anatomical characters are similar to those in other chronic inflammations affecting mucous surfaces—to wit, thickening and more or less infiltration of the mucous membrane, increased proliferation and exfoliation of the epithelial cells, and increased functional activity of the muciparous follicles.

In the adult, chronic laryngitis is common as one of the lesions of the syphilitic or tubercular disease. In the child, syphilitic and tubercular laryngitis is more rare, but the latter sometimes occurs in connection with pulmonary or bronchial tuberculosis. Such patients are emaciated and have the ordinary symptoms of the tubercular disease. Chronic laryngitis also occurs in young children, usually infants, as one of the manifestations of the stru[illegible]ous diathesis. I have records of several such cases, mostly nursing infants.

Some of these patients had mild bronchitis, but it was obviously subordinate to the laryngitis. Their respiration was noisy and harsh, continuing of this character several weeks and even months. The cough was also harsh and loud, conveying the idea of thickening and relaxation of the mucous membrane covering the vocal cords. Their respiration was not notably accelerated and the blood was apparently fully oxygenated, though the friends were often alarmed by the noisy breathing and cough.

In this form of chronic laryngitis expectoration is scanty, the fever slight or absent, the appetite remains unimpaired, and the general condition of the child is good. From time to time exacerbations occur, and occasionally improvement is such as to encourage the hope of speedy cure; but in the cases which I have seen there has not been complete intermission in the disease till the final recovery. Those patients whom I have been able to follow through the disease have recovered in from three or four months to one year.

Chronic laryngitis is to be distinguished from frequent attacks of acute laryngitis which are due to fresh exposures, and also from the laryngitis which is associated with bronchial phthisis. It is to be distinguished from protracted acute laryngitis, which sometimes does not entirely subside in less than a month or six weeks, by its longer duration, the greater thickening of the inflamed membrane, and more noisy respiration. Often chronic laryngitis results from the acute disease, the inflammation being perpetuated by the struma or dyscrasia of the patients.

Anatomical Characters.—In acute catarrhal laryngitis the mucous membrane of the larynx presents the usual appearances of mucous surfaces when inflamed—namely, redness and thickening. It is also more or less softened. Ulcerations rarely, perhaps never, occur in primary acute laryngitis. When present in chronic laryngitis the ulcers are small and situated upon or near the vocal cords. Tubercular and syphilitic ulcers of the larynx are much more rare in children than in adults. The inflammation in simple acute laryngitis usually extends over the whole surface of the larynx and also to the upper part of the trachea. It may be pretty uniform or more intense in one place than another, and, like other mucous inflammations, it is accompanied by more or less proliferation and exfoliation of epithelial cells. In most cases of simple laryngitis, whether acute or chronic, the inflammation extends to the pharynx, producing redness and thickening, though generally moderate, of the mucous membrane which covers it. Examination of the fauces therefore aids in diagnosis.

In the adult œdema glottidis occasionally results from laryngitis. In the child there is little danger that this will occur, in consequence of the anatomical character of the larynx, since in early life the larynx contains but little submucous connective tissue, and therefore less submucous infiltration or exudation occurs during the inflammation. The structural changes occurring in catarrhal laryngitis of infancy and childhood relate almost exclusively to the mucous membrane.

Treatment.—Primary and uncomplicated catarrhal laryngitis requires little treatment. Most cases do well by the employment of suitable hygienic measures, without medicines. Benefit is, however, derived from the use of demulcent drinks and an occasional laxative. A mixture of paregoric and syrup of ipecacuanha or the mist. glycyr. comp. or a small Dover's powder will relieve the cough. For restlessness a warm foot-bath is also useful. Inhalation of the spray of glycerin and water from the atomizer, or of steam, plain or medicated, is also useful. Mildly stimulating embrocations, as by camphorated oil with or without a little turpentine, also aid. It should be rubbed several times daily over the throat, or a strip of flannel soaked with it may be applied around the neck. Chronic laryngitis dependent on syphilis or tuberculosis requires the constitutional treatment which is appropriate for that disease. Measures not specific have little effect upon this form of inflammation. The chronic laryngitis which I have described as occurring chiefly in infancy, and which appears to be of a strumous character, is in most cases obstinate. The patient should be warmly clothed, and constant care should be taken that there be no exposure which would endanger taking cold, as this would produce an exacerbation of the disease and tend to counteract what had been gained by remedial measures. This form of chronic laryngitis is most satisfactorily treated by the application of tincture of iodine upon the neck directly over the larynx, and the internal use of cod-liver oil and the syrup of the iodide of iron.

Spasmodic Laryngitis.

This is a common disease. It is also called false croup, in contradistinction to true or pseudo-membranous croup, and by some continental writers stridulous angina or stridulous laryngitis. It should not be confounded with spasm of the glottis, which is a form of internal convulsions and is not inflammatory. It occurs ordinarily between the ages of two and five years. It is commonly a sporadic affection, but Rilliet and Barthez state that "it is incontestable that it may prevail epidemically." They express this opinion, not from their own observations, but chiefly from those of Jurine, made in the commencement of the present century.

Causes.—Children in some families are more liable to false croup than in others, so that an hereditary tendency to it must be admitted. The exciting cause in most cases is exposure to cold. False croup is not uncommon in the commencement of measles. Narrowness of the rima glottidis and an excitable state of the nervous system, both of which are common in early childhood, are predisposing causes.

Symptoms.—Spasmodic laryngitis is ordinarily preceded for a day or two by a slight cough and fever, by symptoms of mild nasal catarrh, such as all children are liable to on taking cold. In exceptional cases these symptoms are absent and the disease begins abruptly. Singularly, it commences in most patients at night after the first sleep, between ten and twelve o'clock. The sleep is usually quiet and natural, but the child awakens with a loud, barking cough. There is great dyspnœa, and the respiration is harsh or whistling, on account of the narrowing of the chink of the glottis from the swelling and tension of the vocal cords. The face is flushed and expressive of suffering. The child cries, moves from one position to another, wishes to be held or carried, seeking in vain for relief. The skin is hot, pulse accelerated, the voice hoarse or even whispering. After a variable period, usually from half an hour to two or three—not more than half an hour with proper treatment—these symptoms abate. The patient is then somewhat exhausted and falls asleep. The face is less flushed or even pallid, the heat abates, and the pulse is less accelerated. The cough, though less frequent, remains for a time barking or sonorous, and respiration, though greatly relieved, is not at once entirely natural, but it gradually becomes so. In many cases the spasmodic respiration and cough do not recur, but sometimes the attack is repeated once or more, especially during the subsequent nights. The symptoms vary greatly in intensity in different patients.

As the attack declines the disease, losing its spasmodic character, becomes a simple inflammation. In some patients the abatement of the cough and restoration of health are rapid, but oftener the inflammation extends not only into the trachea, but also into the larger bronchial tubes, and a tracheo-bronchitis remains, which gradually declines.

The termination is not always so favorable. Spasmodic laryngitis is, in exceptional instances, the precursor of other serious affections, which may prove fatal. It has been stated that measles often begins with spasmodic laryngitis. Bronchitis, becoming capillary, may occur in connection with it, as may also pneumonia, and by either of these severe inflammations the prognosis may be rendered doubtful. A few cases have been recorded in which it was believed that spasmodic laryngitis was of itself fatal. In some of these the dyspnœa was extreme and persistent and was the cause of death. In a case reported by Rogery, on the other hand, the respiration became easy before death and the pulse more and more frequent and feeble. Death apparently occurred from exhaustion. It is not improbable that had careful post-mortem examinations been made in those cases of spasmodic laryngitis which have ended fatally, other lesions would have been discovered besides those located in the larynx, perhaps tracheo-bronchitis, with an accumulation of mucus in the larynx, producing suffocation, or perhaps in some of the cases congestion of the brain or lungs and serous effusion.

ANATOMICAL CHARACTERS; PATHOLOGY.—The opportunity does not often occur of determining the anatomical characters of spasmodic laryngitis. I have witnessed but one post-mortem examination. A little girl nine years old was taken on Friday night with cough and dyspnœa, indicating a pretty severe attack. The mother, acting through the advice of a friend, gave kerosene oil to her in considerable quantity. This was succeeded by obstinate vomiting and purging, which continued during Saturday and Sunday and terminated fatally on Monday. At the autopsy we found uniform and intense injection throughout the whole extent of the larynx and trachea and in the bronchial tubes, but there was no pseudo-membrane on the inflamed surface and but little mucus and pus. The solitary follicles of the intestines and Peyer's patches were tumefied, and the gastro-intestinal surface was injected in places. The cause of death was obviously the diarrhœa, apparently of an inflammatory character, and probably produced by the kerosene oil. The condition of the mucous membrane of the larynx was that which is ordinarily present in spasmodic laryngitis, though in some cases in which post-mortem examinations have been made the evidences of laryngeal inflammation were slight. Guersant relates a case in which the surface of the larynx seemed to be nearly in its normal state. Death in cases of slight laryngitis is due to causes which are independent of the larynx. In Guersant's case tuberculosis was present.

There is, as has already been intimated, another and a more important element besides the inflammation in the pathology of spasmodic laryngitis—an element producing those phenomena which render it a disease distinct from simple laryngitis. I refer to spasm of the laryngeal muscles. This element pertains to the nervous system, so that spasmodic laryngitis is allied both to the neuroses and to inflammation.

DIAGNOSIS.—The disease for which spasmodic laryngitis is most frequently mistaken is pseudo-membranous croup. The friends, indeed, usually make this mistake in forming their opinion of the case before the physician arrives; and there can be no doubt that many of the cases which have been published in medical journals as true croup were examples of this affection. The points of differential diagnosis are the following: True croup begins with symptoms which at first are slight, so as scarcely to arrest attention, but which gradually increase in intensity. The cough becomes more harsh and the respiration more difficult by degrees. This increase in the gravity of the symptoms occurs by day as well as by night. On the other hand, false croup, though preceded by symptoms of nasal catarrh, commences abruptly. The symptoms have from the first their maximum intensity, and the time at which it commences is at night. Again, the cough in spasmodic laryngitis possesses a loud, sonorous character, while in true croup it is harsh or rough from the presence of the membrane, and having, therefore, less fulness. The voice in spasmodic laryngitis may be hoarse, but it is not lost or is lost only for a short time. It afterward becomes natural or is slightly hoarse. On the other hand, in true croup the voice, from being natural at first, is gradually extinguished. In fatal cases it soon becomes whispering, and continues such till the close of life; in those that recover the voice remains hoarse several days. These differences are important, and if fully appreciated are in most instances sufficient to establish the diagnosis. Besides, in a large proportion of cases of true croup portions of the pseudo-membrane may be discovered on inspecting the fauces, and the faucial surface is deeply injected, while in spasmodic laryngitis there is, with rare exceptions, no false membrane upon the surface of the fauces and but a moderate amount of congestion.

Laryngismus stridulus or internal convulsions must not be confounded with this disease. It is not inflammatory, but purely spasmodic, suddenly commencing and abating—identical, it is believed, in character with tonic convulsions of the external muscles, but affecting the internal muscles of respiration. This disease has already been fully described.

Prognosis.—Little need be added, as regards prognosis, to what has already been stated. While a favorable opinion in reference to the result may ordinarily be expressed, the physician should not forget the fact that death may occur. Symptoms indicating an unfavorable termination are—great and continued dyspnœa, not diminished by the proper remedial measures; stridulous expiration as well as inspiration; lividity of the prolabia and fingers; pallor and coldness of surface; pulse progressively more frequent and feeble. Convulsions and coma may also occur near the close of life.

Treatment.—The indications of treatment are twofold: first, to relieve the spasmodic action of the laryngeal muscles; secondly, to cure the laryngitis. To meet the first indication a warm bath of the temperature of about 100° should be employed as soon as possible after the commencement of the attack. The patient should be kept in it ten or fifteen minutes, in order to obtain its full relaxing effect. In mild cases a warm foot-bath may be sufficient. A second means is the use of an emetic, which should be simultaneous with the bath. To children under the age of three years syrup of ipecacuanha should be given, in doses of one teaspoonful repeated in twenty minutes, till vomiting occurs. Children over the age of three years, unless of feeble constitution, are best treated by the compound syrup of squills in teaspoonful doses, or a mixture of this with syrup of ipecacuanha. It is not often necessary to give more than three or four doses, and sometimes one or two are sufficient to produce vomiting.

In most cases by the use of the warm bath and the emetic the symptoms are rendered milder, and convalescence soon commences.

Dr. R. R. Livingstone[1] reports a case of laryngitis treated by Squibb's ether. It is stated that portions of pseudo-membrane from one-eighth to three-fourths of an inch in length were expectorated; but the symptoms certainly indicated a spasmodic element as decided as in spasmodic croup, and the benefit from the ether was apparently due to the relaxation of the laryngeal muscles which it produced. The treatment of the patient, who was two years old, was commenced by the administration by the mouth of half a teaspoonful of the ether, and followed by its inhalation. "In precisely eight minutes from the time the patient commenced the inhalation the abnormal muscular exertion ceased; a general relaxation took place; the pulse (which had numbered 150) fell to 100." Ether, judiciously employed, will probably prove to be a useful remedial agent in spasmodic forms of laryngitis, whether or not it have any effect on pseudo-membranous formations. A large majority of cases, however, recover speedily without its employment or by the other measures recommended.

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[1] *American Journal of the Medical Sciences*, April, 1867.

Attention should always be given to the state of the bowels in spasmodic laryngitis; if they are not well open a purgative should be administered. For those that are robust and with considerable febrile movement the saline cathartics are ordinarily preferable, as Rochelle salts, or a purgative dose of calomel may be administered. The cathartic should not be prescribed till the nausea from the emetic has subsided. By its derivative effect it tends to diminish the laryngitis, and in severe cases it may obviate the need of depletion by leeches.

Inhalation of the vapor of hot water and the application of a sinapism over the neck and upper part of the sternum, followed by an emollient poultice, are useful adjuvants to treatment.

The most convenient and effectual way of employing vapor is, however, by the atomizer, and as the chief danger is that the inflammation may become pseudo-membranous, I am in the habit of using in the atomizer the officinal lime-water, its solvent action being increased by the addition of the sodium bicarbonate, two drachms to the pint.

When the spasmodic element in the disease is relieved the case becomes one of simple laryngitis, and the general plan of treatment recommended for that malady is proper for this. Small doses of ipecacuanha or of one of the antimonial preparations, as the compound syrup of squills, not sufficient to cause nausea, should now be given at regular intervals. Antipyrine or phenacetin, given every third hour in doses of half a grain, one grain, or one and a half grains, is a useful remedy if the temperature reach 103°. Its effect should be watched, and it should be discontinued when its sedative influence on the circulation begins to be apparent.

If, however, the disease do not speedily terminate by recovery, or more rarely by death, there is nearly always tracheo-bronchitis or a more serious affection coexisting with the laryngitis or following it, so that depressing measures should not be long continued. Expectorants of a stimulating character, as carbonate of ammonium, are required in the course of a few days, and in young and feeble children they should be given at an early period.

The mode of treatment recommended above is appropriate for that large class in whom the inflammatory element predominates. In a smaller number of cases the nervous element predominates over the inflammatory, and the treatment should be in some respects different. Such children are usually pallid and of spare habit, having, indeed, the nervous temperament. They are liable to attacks of this disease, though generally of a mild form, on slight exposure to cold, and with a very moderate amount of inflammation. The treatment in these cases should be directed more to the nervous system. My plan has been in the treatment of such patients, after perhaps the use of a mild emetic, to give quinine, one grain three or four times daily, to a child from three to five years old, prescribing at the same time a simple expectorant and a mildly irritating application to the throat. The symptoms in these cases are not severe and active measures are not required, though the peculiar cough continues longer than in the more inflammatory forms of the malady.

The patient with spasmodic laryngitis should be kept in a warm room during the paroxysms, and should inhale an atmosphere loaded with moisture.

Trousseau recommends a mode of treatment of spasmodic laryngitis which was first suggested by Graves of Dublin. It consists in the application underneath the chin, so as to cover the larynx, of a sponge soaked in water as hot as can be borne; in ten or fifteen minutes it is repeated. This reddens the skin, producing revulsion from the larynx. The hoarseness, dyspnœa, and cough diminish with this treatment, and some recover without other measures.

In rare cases of spasmodic laryngitis the dyspnœa becomes so great, notwithstanding active treatment, that the life of the patient is in danger whether œdema glottidis or thickening and infiltration of the laryngeal mucous membrane be present. In these cases intubation with O'Dwyer's tubes will give prompt relief. Spasmodic contraction of the laryngeal muscles probably also occurs in these cases, increasing the dyspnœa. Recently, in the case of a child of about three years, the dyspnœa was so great in about three hours from the commencement that intubation was performed with immediate relief.

Guersant and others speak of the importance of prophylactic management of children who are liable to this disease. Attention should be given to the dress, so that there may be sufficient protection from atmospheric changes, and there should be an equable temperature of the apartments in which they reside. Children of a decidedly nervous temperament, in whom the slightest laryngitis is liable to be spasmodic, require additional prophylactic measures. They are pallid and in a more or less cachectic state. Such children are benefited by chalybeate and vegetable tonics and by exercise in suitable weather in the open air.

CHAPTER III.

MEMBRANOUS CROUP (DIPHTHERITIC CROUP; TRUE CROUP).

The term pseudo-membranous laryngitis or laryngo-tracheitis or true croup is applied to a common and fatal disease, the essential anatomical character of which is inflammation of the larynx or larynx and trachea, with the formation of a pseudo-membrane upon its surface. It occurs most frequently between the ages of two and twelve years, but infancy after the age of six months and early manhood are not exempt from it. For brevity I shall use the term croup in the following pages to indicate this form of inflammation, although recognizing another form of croup, the spasmodic or catarrhal, in which no pseudo-membrane occurs.

Etiology.—Wherever diphtheria prevails as an endemic or epidemic it is well known that a large majority of the cases of membranous croup are local manifestations of this disease, and this inflammation is therefore in such localities commonly designated diphtheritic croup. Physicians have endeavored to discriminate between croup due to diphtheria and that from other causes; but, whatever the cause, the anatomical characters, the clinical history, and the required treatment are so nearly identical that attempts to differentiate the disease when produced by other agencies than diphtheria from that due to diphtheria have proved futile and unsatisfactory in localities where diphtheria occurs, except in a few instances; as, for example, when croup has been manifestly caused by swallowing or inhaling some irritating agent.

Inflammation of the laryngeal and tracheal surface, whatever its cause, whenever it reaches a certain grade of severity may be attended by the exudation of fibrin and the formation of a pseudo-membrane; but such a result more frequently occurs in the inflammation caused by diphtheria than in that produced by other agencies. In diphtheria a moderate laryngo-tracheitis is attended by the pseudo-membranous formation.

The percentage of cases of diphtheria in which the larynx becomes implicated and croup occurs varies in different epidemics and in different seasons and localities. In epidemics of a mild type the cases appear to be fewer in which the larynx is involved than in epidemics of a severe form. In New York the percentage is large. From December 1, 1875, to July, 1878, I preserved records of all the cases of diphtheria which came under my notice. The number was 104, and in 25 of these, or about 1 in 4, croup occurred, producing the usual obstructive symptoms and constituting the chief source of danger. During the two and a half years embraced in these statistics the disease was usually severe. Subsequently amelioration occurred in the type of diphtheria in this city, and the proportion of croup cases has not been so large.

So commonly is membranous croup, when occurring in a locality where diphtheria is endemic or epidemic, a local manifestation of diphtheria that physicians in such localities come to regard every case of this disease of the larynx as produced by the diphtheritic poison. In New York physicians scarcely recognize any other form of membranous croup. It is well, therefore, briefly to recall the evidences that croup in a certain proportion of cases results from other causes than diphtheria. The occurrence of croup in localities where diphtheria is unknown of course indicates the operation of some other agency than the diphtheritic poison. Thus, in 1842, before diphtheria was established in this country, Dr. John Ware of Boston published his well-known paper on croup, and in 74 of the 75 cases embraced in his statistics the membranous exudation was present upon the faucial surface. The statistics relating to the introduction of diphtheria into New York City and the recorded death-statistics of this city have been annually published, and each year more or fewer deaths from croup have been reported. The first death from diphtheria in this century within the city limits, certified by a physician, was that of a German woman at 638 Hudson street on February 15, 1852. Two other fatal cases occurred in 1857, and since then the deaths from croup and diphtheria have been as presented in the following table:

Year.	Croup.	Diphtheria.
1858	478	5
1859	622	53
1860	599	422
1861	460	453
1862	685	594
1863	908	981
1864	754	781
1865	449	534
1866	368	435
1867	338	251
1868	342	276
1869	483	328
1870	421	308
1871	466	238
1872	675	446
1873	732	1151
1874	594	1665
1875	758	2329

Since 1875 weekly bulletins have been issued instead of the annual reports.

Thus, in the first years after the introduction of diphtheria the deaths assigned to croup so greatly outnumbered those of diphtheria, as in 1858, when 5 died of diphtheria and 478 of croup, that it is evident that most of the cases of croup in those years were attributable to other causes than diphtheria. Since, as we have stated, any inflammation of the surface of the larynx and trachea, if sufficiently intense, may produce a pseudo-membrane, croup may occur as a primary disease and as a complication of various maladies. According to my observations in New York City, the chief causes of croup, arranged in the order of frequency, would be about as follows: Diphtheria, "taking cold," measles, pertussis, scarlatina, typhoid fever, irritating inhalations. I have elsewhere related cases of scarlet fever of severe type in which a thin film of pseudo-membrane was found upon the surface of the larynx and trachea, and there was no other lesion to indicate that diphtheria had supervened. The croup was, to all appearances, caused by the scarlatinous and not the diphtheritic poison. The following was a case in which croup was apparently idiopathic, and produced by that common cause of inflammations of mucous surfaces—to wit, exposure to sudden atmospheric changes.

CASE.—At midnight on October 22, 1884, I was summoned to a child aged twenty-five months who had been in the street till nearly nightfall, when the weather suddenly became much cooler and he was brought home. At 11.45 P. M. he awoke with a harsh voice and croupy cough, so as to alarm the family. I found the axillary temperature normal, but the fauces were injected, and the diagnosis was made of spasmodic or catarrhal croup. Emesis was produced by syrup of ipecacuanha; the croup kettle and a mixture of potassium chlorate and ammonium chloride were ordered.

On the following day he walked around the room and seemed better, but the inhalation of the vapor of lime from the croup kettle was continued. At 7 P. M. the symptoms became aggravated, the cough was frequent and hoarse, temperature (axillary) 102¾°, pulse 120, and respiration noisy. At my visit the postclavicular, suprasternal, inframammary, and epigastric regions were depressed in each inspiration, though only to a moderate degree; face flushed; fauces injected, but without pseudo-membrane. The aspect was now more serious on account of the increasing dyspnœa. The pulse was strong and no pseudo-membrane was visible; the temperature in the groin was scarcely 100°. Emesis had been produced before my arrival, and in the matter vomited was a pseudo-membrane with ragged edges and about one-half an inch in length; examined within an hour subsequently under the microscope, it was found to consist of fibrillæ, evidently fibrinous, some of them wavy, and enclosing many pus-cells. Ten grains of calomel were placed on the tongue, and inhalations of the following were almost constantly employed by the steam-atomizer:

℞. Liq potassæ, ℥ij;
Aq. calcis, ℥xij. Misce.

On the following day the respiration was easier, and within twenty hours the patient had so far convalesced as to be out of danger. There had been no case of diphtheria in the house, nor recently, so far as I could learn, in the immediate neighborhood.

That this was a local disease, non-specific and quite distinct from the croup of diphtheria, cannot, I think, be doubted.

In considering the etiology of croup, and recognizing diphtheria as by far its most common cause wherever the latter disease prevails, an interesting theory is suggested to which Heubner alludes, who affirms that inflammations, even with the characteristic membranous exudation, may be set up without the specific microbe of diphtheria, and then inoculation by the microbe occurs and "induces the general disease."[1] The point alluded to is that inflammations arising from other causes than diphtheria now and then become intensified and are rendered more protracted and dangerous by the reception of the diphtheritic virus after the inflammations are established. In support of this opinion it is well known by all who have had much experience with diphtheria that those surfaces are prone to be attacked by the specific inflamma-

[1] "Die experimentelle Diphtherie," Leipzig 1883, quoted in Ziegler's *Pathol. Anat.*, [illegible] p. 444, 1884.

tion that are already irritated or inflamed when diphtheria is contracted. (This subject is alluded to in our remarks on Diphtheria.)

Scarlatina is so often complicated by diphtheria that there seems to be a close affinity between the two diseases. It is a very common observation in New York City that scarlet fever continues two or three days in its usual form, when the symptoms become suddenly aggravated and the aspect of the disease more severe. On inspecting the fauces a pseudo-membrane is discovered covering this region, and it probably appears also upon the nasal surface. Although severe scarlatinous inflammation may cause a fibrinous exudation, yet that diphtheria has supervened upon scarlet fever in a considerable proportion of cases which have the above history cannot, I think, be doubted. In a few instances in my practice (four) the fact that scarlet fever was complicated by true diphtheria, and the scarlatinous inflammations, first in order, were intensified by the presence and influence of the diphtheritic poison, was shown by the occurrence of diphtheria without scarlet fever in other members of the family.

In accordance with the above law we may assume that a child who has laryngo-tracheitis, so common from taking cold and manifested by cough and hoarseness, is more prone to have diphtheritic croup than is one whose air-passages are in their normal state when diphtheria commences. A supposed error of diagnosis is often made by physicians, always to their discredit, who diagnosticate catarrhal laryngitis, but find after two or three days that their patients really have diphtheritic croup. A considerable number of such instances have come to my notice, always with the ill-will of families toward their physicians. Now, it seems to me that in many of these cases the physicians have been right in their first diagnosis, and diphtheritic croup supervened on the catarrhal inflammation.

Another point relating to the etiology of diphtheritic croup requires notice. Many physicians who have had ample opportunities to observe diphtheria believe that the common way in which diphtheritic croup begins is as follows: The faucial or nasal surface is first affected, becoming covered by the peculiar exudation, and during inspiration particles of the pseudo-membrane containing the specific principle, being detached, lodge in the larynx. At the point of inoculation the specific inflammation arises and extends. This may be the manner in which the croup of diphtheria begins in certain cases, but it certainly does not apply to a considerable number of patients. Thus both the faucial and nasal pseudo-membranes may be treated every second or third hour from the time of their formation with the best disinfectants which we possess, so as to destroy all the micrococci in them and render them an inert mass, and yet croup not infrequently occurs during the progress of the case. Again, in certain cases croup begins at the commencement of the diphtheritic attack. The laryngitis commences as early as the pharyngitis, and therefore does not result from it. Sometimes the inflammation of the air-passages is from the first the predominant lesion, the pharyngitis being subordinate or even trivial. Thus, a boy of two years ten months whom I attended died of croup lasting about four days. He lived in the suburbs of the city, where the houses were scattered and where there had been no recent diphtheria. The attack began with hoarseness, which gradually increased to a fatal obstruction in the air-passages. Close and repeated inspection of the fauces revealed only redness and some swelling of the parts that were visible, and the symptoms indicated but slight coryza. The diphtheritic nature of the disease was rendered certain by the occurrence of diphtheria in its usual form in the two nurses immediately after the death of the child. In this case croup began at the beginning of the sickness, and it is evident from the history of the lesions that the contagium was not transferred to the larynx from any of the other surfaces. In view of the number of such cases I see no propriety in assigning to diphtheritic croup a mode of origin different from that of other diphtheritic inflammations. But the possibility, and perhaps probability, in some instances of an auto-infection we will not deny.

ANATOMICAL CHARACTERS.—It is important to acquaint ourselves with the anatomical characters of croup, especially with the nature of the pseudo-membrane, that we may know what measures to employ in order to remove it and prevent, so far as possible, the laryngeal stenosis from which so many perish. The surface of the larynx, trachea, and in severe cases that of the bronchial tubes, is hyperæmic and swollen, and the inflammatory action involves more or less the submucous connective tissue, causing infiltration or œdema. The relation of the exudation to the mucous surface varies according to the kind of epithelium present. Where the epithelium is of the flat or squamous variety the fibrinous exudation from the blood-vessels is poured out around the epithelial cells, which perish. If the inflammation extend more deeply, the underlying connective tissue is also embraced in the coagulation and perishes. Prof. Ziegler of Tübingen, who has made repeated microscopic examinations of the pseudo-membrane, says: "It sometimes happens that the dead epithelial cells become saturated with the exuded liquid, and then pass into a peculiar condition of rigidity akin to coagulation. The seat of this change appears to the naked eye as a dull, raised, grayish patch surrounded by red and swollen mucous membrane. The exudation is rich in albumen, and the transformed cells take on the appearance of a kind of coarse meshwork almost or altogether devoid of nuclei." This is superficial inflammation, and Prof. Ziegler next describes deep or parenchymatous inflammation, as follows: "It is characterized by the coagulation not merely of the epithelium, but also of the underlying connective tissue. The affected patch is swollen and assumes a whitish or grayish tint, the discoloration extending through the epithelium to the connective-tissue structures. The epithelium in some cases is lost altogether, and then the diphtheritic patch consists of dead connective tissue only. . . . . The dead tissue is separated from the living by a zone of cellular inflammation. Fibrinous filaments are seen here and there through the mass. The lymphatics in the neighborhood contain coagula and leucocytes."

Squamous epithelium covers the nostrils, buccal cavity, fauces, and larynx upon and above the superior vocal cord, with the exception of its anterior aspect. The pseudo-membrane, therefore, upon all these surfaces lined with this form of epithelium consists of the exudate from the blood which surrounds and permeates the epithelium or epithelium and subjacent connective tissue. These two distinct elements, that poured out from the blood-vessels, and the normal tissue of the mucous surface now dead, incorporated in one mass, constitute the pseudo-membrane. Its intimate relation with the surrounding living tissue is such that we cannot detach it without lacerating the latter and causing hemorrhage.

The anterior aspect of the larynx from the middle of the epiglottis downward, all that part of the larynx below the superior vocal cord, the entire trachea, and the bronchial tubes, are lined by columnar epithelium. Whenever this variety of epithelium is present the exudate from the blood does not become incorporated with the mucous membrane, but escapes to the surface and coagulates in a layer over it. It is, therefore, loosely adherent to the underlying tissues, being attached to it by some fibrinous threads, and when it is peeled off the hyperæmic and swollen mucous membrane is seen underneath in its entirety, unless, as is commonly the case, a considerable part of its epithelium has been shed and been expectorated. The loose attachment of the pseudo-membrane in the trachea and bronchial tubes is of the greatest significance in its relation to intubation and tracheotomy.

In this connection it is proper to call attention again to the confusion which occurs in the use of the terms diphtheritic and croupous as employed by pathologists on the one hand and clinical observers or practitioners on the other. Pathologists, following Virchow, designate the inflammation "diphtheritic" when the epithelium and underlying tissues remaining *in situ* are blended with the exudate and become a part of the pseudo-membrane, whatever may be the cause of the inflammation; and they designate the inflammation "croupous," whatever its cause, when the exudate escapes to the surface of the mucous membrane, as in the trachea and bronchial tubes, and coagulates upon it. Therefore, in all cases of pseudo-membranous inflammation of the air-passages, even that due to "taking cold" or to inhalation of an irritating vapor, they term the laryngitis diphtheritic, since in the larynx the exudate is incorporated with the mucous membrane, while the pseudo-membranous tracheitis or bronchitis in the same patient is termed croupous, since the exudate lies upon the surface. Practitioners, on the other hand, apply the term diphtheritic to all inflammations which occur as local manifestations of the specific disease, diphtheria, and to only such inflammations, whatever may be their form, whether pseudo-membranous or catarrhal.

The epithelial cells embraced in the pseudo-membrane undergo a histological change. We have stated Ziegler's remark that they are permeated by the exudate of the blood. Cornil and Ranvier say: "Wagner admits the fibrinous degeneration of the cells. . . . . We have verified the description given by Wagner, but we would conclude that the cells are filled with a material which approaches mucin rather than fibrin." In the first week the pseudo-membrane forms more rapidly, and is usually thicker and more extended, producing dyspnœa more quickly than when it forms in the declining stage of the disease. If the membrane be detached by the forcible coughing of the patient, it is usually quickly reproduced, unless the diphtheria be in its advanced stage and abating. If the croup continue from four to six days, the pseudo-membrane begins to soften from commencing decomposition and to disintegrate. The minute fibres which attach it to the membrane give way, and in favorable cases by the effort of coughing or vomiting it is thrown off. Separation is aided by the muco-pus which collects underneath.

SYMPTOMS.—Whenever croup is one of the local manifestations of diphtheria, such general or constitutional symptoms are present as commonly pertain to this blood disease, such as fever, anorexia, thirst, and progressive loss of flesh and strength. The temperature in the commencement in croup from this cause is usually higher than at an advanced period, unless some complication occur, as pneumonia, which increases the heat of the system. The temperature is not, however, in the beginning ordinarily above 103° or 104°, and as the croup continues and the systemic blood-poisoning becomes more marked, the temperature usually falls, so that even in the gravest cases it is often at or below 100°. Most patients also have those inflammations which commonly attend diphtheria—*i. e.* pharyngitis and more or less coryza, but they are relatively unimportant in comparison with the croup, for, unlike the croup, they do not in themselves involve immediate danger to life.

Croup commonly begins gradually and insidiously, revealed at first to the physician by hoarseness or huskiness of the voice and a hoarse or harsh cough. Both voice and cough are feeble, lacking the fulness and sonorousness present in spasmodic laryngitis. In grave cases approaching a fatal termination the voice becomes more and more indistinct, and finally is suppressed. The cough also, which in the beginning of the croup was strong and expulsive, becomes feeble and ineffectual, and less frequent as the fatal result draws near.

The amount of sputum varies considerably in different cases. If the inflammation extend no farther downward than the trachea it is scanty, but if there be coexisting bronchitis it is more abundant, consisting of muco-pus with occasional flakes of pseudo-membrane. By vomiting a larger quantity is expelled than by the cough. Occasionally masses of pseudo-membrane of considerable size are expectorated, even moulds of some part of the respiratory passage, always with great temporary relief to the patient. A pseudo-membrane of considerable thickness and extent obstructs the expectoration of muco-pus, which, collecting in the lower part of the trachea and in the bronchial tubes, greatly increases the dyspnœa. The respiration is somewhat more frequent than in health, but it is not notably increased except when bronchitis or broncho-pneumonia is present. At an advanced stage, when stupor supervenes from non-oxygenation of the blood, the respiration may be slower than in health.

Croup in its commencement and in the active period of diphtheria without treatment almost never remains stationary or abates. Little by little, or often quite rapidly, the laryngeal stenosis increases, and soon the patient begins to experience the want of air. He becomes restless, has an anxious expression of the face, seeks change of position, reaching out his arms to the nurse or mother to obtain relief. In some patients only a few hours elapse and in others a day or more of gradual increase in the obstruction, when it becomes evident that death must soon occur unless relief be afforded. In this stage the post-clavicular, infraclavicular, suprasternal, and inframammary regions are depressed during inspiration, and the larynx is drawn with each inspiratory act toward the sternum. While there is constant suffering, there are also occasionally most distressing attacks of dyspnœa, attended by an increase in the lividity of the features and extremities, which now have an habitual dusky pallor. Sometimes these attacks are perhaps due to the doubling of a detached end of the pseudo-membrane on itself, or perhaps to a movement of the muco-pus by which bronchial tubes are occluded. With the ear applied over the larynx or upper part of the sternum, a loud rhonchus is heard both on inspiration and expiration, produced by the passage of the air over the obstruction, and obscuring to a great extent the other sound. Moist bronchial râles are also common.

Those who recover from membranous croup without intubation or tracheotomy and by the use of inhalations—and thus far they constitute only a small minority—usually improve gradually, the obstruction diminishing by the softening and detaching of portions of the pseudo-membrane, the cough becoming looser and the voice less hoarse. After the detachment of the pseudo-membrane several days elapse before the thickening and infiltration of the mucous membrane disappear and the epithelial cells are restored.

Diagnosis.—Catarrhal laryngitis with an unusual amount of thickening and infiltration of the mucous membrane and of the underlying connective tissue, so as to produce stenosis and obstruct respiration, may be mistaken for pseudo-membranous laryngitis. In the New York Foundling Asylum two children have at different times died with the symptoms of membranous laryngitis, and the obstruction was found to be due entirely to the thickening and infiltration of the mucous and submucous tissues of the larynx by newly-formed corpuscular elements. Of course, death from catarrhal laryngitis is rare, but that this disease may produce such an amount of laryngeal stenosis as to cause even fatal dyspnœa, like that from the presence of pseudo-membrane, these two cases show. In most instances the diagnosis of membranous laryngitis from catarrhal laryngitis is easy by the presence of patches of pseudo-membrane on the fauces or by the history of the case, which evidently points to diphtheria as the cause. In the case alluded to above a child in my practice died with the symptoms of acute laryngeal stenosis, without any pseudo-membrane upon visible parts and with only a moderate pharyngitis. This case, which might have passed as one of catarrhal laryngitis accompanied by an unusual amount of cellular and serous infiltration, as there was no known diphtheria in the vicinity, was really due to diphtheria, and was a local manifestation of that disease, for immediately after the death of the patient the two nurses had unequivocal symptoms of diphtheria. The difficulty in using the laryngoscope in young children is such when their fauces are swollen that it has not heretofore afforded much aid in the differential diagnosis of the various forms of acute laryngeal stenosis in young children, at least when employed by the general practitioner.

PROGNOSIS.—The mortality from croup obviously depends to a great extent on the prevalence and the type of diphtheria. From what has been stated above, it follows that croup is more frequent and more fatal when a grave form of diphtheria is prevailing than in mild epidemics with less blood-poisoning. In New York City, during the fifteen years ending with 1878, the percentage of recoveries was very small, both under medicinal treatment and tracheotomy. During this long period, surgeons, not saving more than 3 to 5 per cent. of their cases by tracheotomy, performed this operation reluctantly. But since 1878 the percentage of recoveries after tracheotomy has been much greater. The mortality from croup is greater the younger the patients; for the younger the child the less the diameter of the air-passages and the more quickly laryngeal stenosis results. The younger the child, also, the more difficult is the use of the proper remedies, and the less the time for their use before fatal dyspnœa occurs. We have already said that croup appearing in the declining stage of diphtheria is less severe and more easily controlled or cured than when it occurs in the commencement of this disease. Much depends also upon whether the physician is summoned at the beginning of croup and appropriate remedies are early and persistently employed. In many instances the friends do not take alarm and the physician is not summoned till the disease is well under headway and there is not the requisite time for the action of inhalations. Obviously, also, croup, beyond all other diseases, requires faithful and intelligent nurses, for without the co-operation of such nurses night and day in the care of the patient the most judicious measures are often inefficient.

Exact statistics are lacking to show what proportion of cases of croup recover by strictly medicinal treatment. If we regard as incipient croup those cases in which the voice becomes hoarse or harsh, but no dyspnœa occurs, and the lungs are fully and normally inflated, a considerable number —I think more than 50 per cent. in my practice—recover. There may be in these cases a catarrhal laryngitis, or there may be a thin film of pseudo-membrane upon the laryngeal surface, not sufficient to embarrass respiration. Slight laryngitis, therefore, occurring in the course of diphtheria, unaccompanied by any increase in temperature or change in the freedom or rhythm of respiration, and whose only symptom is a huskiness of voice, if treated early and properly by inhalations passes off in a few days in a large proportion of cases. It possesses little importance, except that it might be the initial stage of croup if neglected. It is obviously improper to consider this trivial form of laryngitis as membranous croup, although by neglect it might become such. In the statistics of croup those cases only should be included in which the symptoms are so pronounced that it is evident that more or less laryngeal stenosis is present, although there may as yet be no marked dyspnœa.

In determining the percentage of recoveries in croup it is proper to arrange cases in two groups: 1st, cases which have received only medicinal treatment; 2d, cases in which intubation or tracheotomy has been performed. Having been in almost continuous practice since diphtheria began in New York, in a section of the city where this disease has always been prevalent, and having witnessed all kinds of treatment—that by emetics, by depletion, by stimulation, by inhalation and insufflation—it is my opinion that not more than one in eight has recovered by medicinal treatment in this long period, of cases of croup which began in the first week of diphtheria, and in which the symptoms were so pronounced as to indicate more or less laryngeal stenosis. The exudation in the first week of diphtheria, or in its active period, occurs so rapidly and in such large quantity that no one of the medicinal agents or modes of treatment which physicians commonly prescribe is sufficiently prompt in its action to prevent the formation of the pseudo-membrane to an extent that soon endangers life. I allude to what has hitherto been the result.

Perhaps we may yet discover a mode of treatment that more effectually controls the formation of pseudo-membranes.

Croup occurring in the second or third week of diphtheria, since it is attended by less abundant and less rapid exudation than when it occurs during the acute stage, can be more successfully treated under the persevering use of solvent inhalations, and, according to my observations, a larger proportion of such cases than 1 in 8—perhaps 1 in 4—recovers by the early and continuous or almost continuous use of inhalations.

Still the mortality is so large and the suffering so great in croup, at whatever stage of diphtheria it occurs, that we cannot rely on the slow action of medicines or inhalations, and surgical treatment is in most instances required to diminish the suffering and afford the best chances for saving life. Intubation of the larynx by O'Dwyer's tubes is rapidly coming into use as a prompt and efficient method of relieving laryngeal stenosis. The percentage of recoveries after intubation will be considered hereafter, but enough is known to render it certain that this simple and painless operation will soon be performed as a substitute for tracheotomy in every part of the world where there is a medical profession worthy of the name. The following statistics show the result of tracheotomy when skilfully performed:

	Cases.	Recoveries.	Deaths.	Per cent. of recoveries.
Jacobi, Krackowizer, and Voss (*Amer. Jour. of Obstet.*, May, 1868)	166	39	127	
J. H. Ripley, *N. Y. Med. Rec.*, 1880	56	16		
Parisian Children's Hospital, 1851–75 (Tenné)	4663	. .	. .	24
Bethanien in Berlin, 1861–72 (Bartels)	330	103	. .	31.2
Berliner Chirurg. Klinik, 1870–76 (Krönlein)	504	147	. .	29
St. Annenspital, Wien (Monti)	210	. .	. .	33
Table of Monti from various sources	2608	. .	. .	25
Hofmohl's statistics	3760	. .	. .	27
Küster's statistics	1556	. .	. .	32
C. Hospital, Trousseau, Paris, during 1883 (per Dr. L'Enfance)	359	115	244	32
Clinic of the Zurich Kantonspitals, under Rose and F. Krönlein, 1868, March, 1882 (11 under two years, 1 of eight months)	238	92	. .	39
Deutsche Zeitschrift für Chirurg., 1882, Bd. xvii. (H. Lindner)	101	. .	. .	37⅗
Statistik der Tracheotomie per Croup, *Deutsche Chirurger Lieferung*, 37 Stuttgard, 1880, by Kühn	277	125	152	
Hôpital des Enfants Malad., Paris, 1850–57	389	86	. .	22
Hôpital des Enfants Malad., Paris, 1860–67	813	208		
Trousseau, according to Kühn	466	126	. .	25
Guersant (Sédillot), *Med. Opér.*, ii., page 480	171	36	. .	21
Barthez, Hospital St. Eugénie, 1855–68	573	160	. .	28
Cases in the Parisian Hospitals and in the Provinces, Fascher et Bricheteau	1011	. .	. .	25
Roser (Lissard) C. C., 1854–61	42	19	. .	45¼

	Operations.	Recoveries.	Per cent. of recoveries.
Uhde, *Archiv f. klin. Chir.*, 1869, 1820–69	81	21	25
Max. Muller (*Langenb. Arch. f. klin. Chir.*, vii)	45	15	33
Bardenheuer (Colner Bürgerhospitals, 1875–76)	129	46	35.6
Krankenhause Bethanien, 1873, and following (H. Settegast)	375	119	31.75
Billroth, *Chirurg. klinik. Wien*, 1871–76	18	1	
Reisz, *Bronchotomiens Indicat.*, 1858	17	5	
Wansher (*Copenhagener Kommuni Hospitals*, Sept., 1863–Dec., 1876)	400	170	42.5

The result of tracheotomy in infants is much less favorable than in older children. Dr. Gustav Chagin[1] has published the statistics of cases in infancy. These cases, 977, occurred since 1874, and of this number, 832, or 85 per cent., died. In the Copenhagener Kommuni Hospital, in which, as stated above, there was the remarkably good general result of 170 recoveries in 400 tracheotomies, only 5 per cent. recovered of children under one year; of 76 operated on between the ages of one and two years, 22 recovered, or 29 per cent.; while of 296 operated on between the ages of two and ten years, 146 recovered, or 49.3 per cent. In the Krankenhause Bethanien the results of tracheotomy from the beginning of 1861 to the close of 1876, tabulated according to the age, were as follows (H. Settegast):

Years.	Tracheotomies.	Recovered.	Per cent.
2 to 3 years	93	22	23.65
3 " 4 "	165	47	28.45
4 " 5 "	175	54	30.85
5 " 6 "	107	39	35.45
6 " 7 "	90	34	37.77
7 " 8 "	59	17	38.86
8 " 9 "	24	11	45.83
9 " 10 "	15	6	40.00

The statistics show that the older the patient upon whom tracheotomy is performed, other things being equal, the greater the percentage of recoveries. Prof. Abraham Jacobi has probably performed tracheotomy for croup in as many cases as any other physician or surgeon in this country—not fewer, he thinks, than four hundred times. His opinion corresponds with the common belief that in recent years the percentage of recoveries after tracheotomy in New York City has been larger than in previous years, and the operation is performed more frequently by the attending physician than formerly. The result of tracheotomy during a long series of years, ending with 1878 or 1879, was so unfavorable, on account of the type of the disease, that Dr. Jacobi thinks that in the aggregate of his cases of tracheotomy since 1858 only about 12 per cent. recovered.

Although at present in this city the percentage of recoveries after tracheotomy is larger than formerly, yet the statistics of some of the prominent physicians and surgeons show nearly as large a proportion of deaths as in former years, probably because the operation has been deferred till the patients were nearly moribund. Thus, one surgeon records only 4 recoveries in 21 operations during three or four years, and a physician of large experience connected with one of the institutions where children are treated has been equally unsuccessful in his tracheotomies, but he has operated only when the dyspnœa was extreme and death momentarily expected. Earlier operation might have given better results.

The statistics of recent tracheotomies, which seem to me to indicate most accurately the results of this operation when skilfully performed, and not at too late a stage in the type of diphtheria now prevailing in this city, I have obtained from Drs. J. H. Ripley and Fred. Lange. The operations embraced in their statistics were performed since January 1, 1879, and before intubation came into general use, with the following result:

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[1] *Archiv für Kinderheilkunde*, Bd. iv.

Tracheotomies.	Died.	Recovered.	Per cent. of recoveries.
66	44	22	33⅓

These surgeons did not select cases for the operation, but operated on nearly every patient with croup to whom they were summoned, provided that death appeared inevitable without tracheotomy. They operated even if serious complications were present, as nephritis or pneumonia, or the blood were profoundly poisoned.

Some physicians in this city make greater discrimination in cases, and do not operate if the condition of the patient be such that death will in all probability occur after tracheotomy. They do not, therefore, advise the operation if the patient have profound blood-poisoning or severe local disease elsewhere than in the air-passages. Such physicians by the early performance of tracheotomy and by careful attention to the after-treatment, making frequent visits and supervising the details of the management, furnish more favorable statistics of the operation than those published above. Thus, Dr. A. R. Robinson, who carefully considers the indications and contraindications of tracheotomy, who operates early, does not insert the canula until all loose muco-pus and shreds of pseudo-membrane are expelled by the cough from the trachea and bronchial tubes, and who supervises by frequent visits the after-management, has saved, since 1880, 11 in 13 consecutive cases of undoubted membranous croup. It is seen from the above statistics that we can claim from tracheotomy, judiciously performed and at a sufficiently early stage, the cure of 1 in every 3 patients on the average. The statistics in Boston show that the results obtained in that city in hospital practice have been about the same as those in New York and in European cities. In an interesting paper on tracheotomy in croup, published in the *Medical News*, July 12, 1884, the writer says: "Tracheotomy for this disease has been performed 118 times at the Boston City Hospital during the past twenty years: 39, or 1 in 3, were successful. That the cases were not selected is shown by the fact that 3 patients died during the operation from shock and exhaustion, not from hemorrhage; 34 died within twenty-four hours; and 56, or more than one-half of the fatal cases, within forty-eight hours; 4, if not 5, of the successful cases were practically moribund at the time of the operation. . . . . The ages of these patients ranged from nine months to forty-one years. The youngest to recover was eleven months, the oldest sixteen years; 4 aged two years and 5 aged three years got well. Membrane was visible in the fauces or trachea in a large proportion of both the successful and unsuccessful cases. Its absence was noted in only 3 of each class. It need not be said that in every instance there was present severe, constant, and increasing dyspnœa, exhausting the strength and threatening suffocation."

TREATMENT—*Preventive.*—In attending a case of diphtheria the physician should notice at each visit whether the patient have any hoarseness or other signs indicating implication of the larynx, since if the danger be recognized at its inception it may perchance be averted. Ineffectual as inhalations may be for fully-declared croup, we have seen, in speaking of the prognosis, that experience fully justifies the belief that they are sufficient in a large proportion of cases to relieve that degree of laryngitis which is indicated by simple hoarseness, and which if it continue might eventuate in serious obstructive disease. If the physician observe such symptoms, he should immediately recommend that the air in the apartment be kept moist by the croup kettle or pans of hot water over the fire, into each of which a lump of lime is placed. I frequently surround the bed with a tent made with a clothes-horse, over which blankets are thrown, and place the croup kettle underneath. Frequently stirring the water in the kettle adds to its efficiency. I prefer, however, in most instances, to employ the steam-atomizer either with or without the croup kettle. It should be so constructed that it throws a heavy spray of rather turbid lime-water, and should be almost continuously used as long as the premonitory symptoms of croup continue. It obviates the necessity of heating the apartment, which in hot weather is very uncomfortable.

It is proper, in this connection, to consider which is the most efficient and the best agent for inhalation in croup. Have we an agent that can be safely used, which will prevent, when inhaled, the formation of the pseudo-membrane, or which will dissolve it when it has already formed? The agents which have been most employed for this purpose are lime-water, lactic acid, pepsin, and trypsin.

In selecting the one that is safest and most efficient, the important fact should be borne in mind that anything which irritates, so as to increase the inflammation of the mucous surface, is injurious. Whatever intensifies the inflammation evidently augments the thickening and infiltration of the mucous membrane and increases the area as well as thickness of the pseudo-membrane. It is therefore harmful instead of beneficial. In my opinion, the teachings of Bretonneau and Trousseau did immense harm in the fact that they brought into use agents far too irritating to the sensitive mucous surface. Since the pressing danger in croup arises from the obstruction produced by the pseudo-membrane and by the thickening and infiltration of the mucous membrane underneath, that agent is indicated, if it can be found, which loosens and dissolves the pseudo-membrane, and at the same time tends to diminish, or at least does not increase, the inflammation of the underlying tissues by its irritating action. Alkalies exert a solvent action on fibrin and mucin, and as the pseudo-membrane consists of the exudate from the blood largely fibrinous, and of epithelium and connective tissue which have undergone degeneration into a substance resembling fibrin (Wagner), or perhaps mucin (Cornil and Ranvier), their employment seems to rest on a sound therapeutic basis. Lime-water slightly turbid, but not so turbid as to clog the point of the steam-atomizer, with its alkalinity increased by the addition of an unirritating alkali, should be employed almost continuously by inhalation. Dr. E. M. Moore[1] of Rochester recommends insufflation of sodium bicarbonate as an active solvent of the pseudo-membrane. It possesses this advantage—that it is but slightly irritating, so that it can be used in substance or with but little dilution. For this reason it should be preferred to lime-water, which is in more common use.

Recently I have employed in the steam-atomizer the following formula, with good results:

Sodii bicarbonat.,	ʒij;
Aquæ calcis,	Oj. Misce.

Trypsin may be advantageously used with this liquid, but trypsin in powder is very likely to clog the atomizer. The liquid trypsin, as prepared by Fairchild, should therefore be employed with the lime-water. Pepsin, as we have stated elsewhere, is incompatible with an alkali.

By the persistent and timely use of such inhalations as soon as hoarseness appears croup can be often prevented. But we all know how frequently, notwithstanding our best endeavors, croup occurring in the first week of diphtheria grows hourly worse. In these acute and rapid cases inhalations of the best agents which physicians have hitherto used act too slowly to prevent the growth of the pseudo-membrane, and in a few hours it becomes painfully evident that something more must be done or the life of the child is lost. In those many cases in which diphtheria is ushered in with croupous symptoms, and in which within a few hours laryngeal stenosis begins to occur, the experienced physician sees at a glance, often at his first visit, that inhalations, however faithfully employed, will be inadequate, and that suffocation, the most painful of all modes of death, will be inevitable unless other and energetic measures are used.

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[1] *Transactions of the N. Y. Medical Association*, 1885.

On the other hand, in the milder forms of croup, in which the exudation has but moderate thickness and forms slowly, inhalations are of the greatest service, and aided by internal remedies they not infrequently arrest the disease and save life. The following was such a case: "M. J——, a girl of two years and five months, took diphtheria on January 6, 1884. I first saw her on the 9th, when a considerable amount of pseudo-membrane covered the fauces. The temperature was but moderately elevated, and a slight discharge occurred from the nostrils. Under the usual treatment the pharyngitis abated, and she seemed to be convalescing until January 14th, when her respiration began to be noisy and embarrassed. On inspecting the fauces a pseudo-membrane was seen upon the aperture of the glottis, apparently dipping down into it. The steam-atomizer was employed almost constantly, throwing a spray of lime-water with about 1 per cent. of liquor potassæ. Each inspiration was accompanied by marked depression of the post-clavicular, epigastric, and inframammary regions, and the respiration was noisy and embarrassed till the 17th, when it began to improve, and the patient was soon out of danger. It will be observed that the croup commenced in the second week or in the declining stage of diphtheria. Had it been earlier, when the inflammation was more active and the exudation more rapid, in all probability the patient would have perished unless saved by tracheotomy. The slowness of the exudative process afforded time for the action of solvent inhalations.

Nearly at the same time that this case occurred a patient in my practice who had recovered from croup by tracheotomy was seized with dyspnœa a month after the operation, when the opening had healed, and a flapping sound could be distinctly heard, produced probably by a pseudo-membrane which was partially detached. This obstruction, which for a time apparently involved great danger from the dyspnœa which it caused, was removed by the third day under alkaline inhalations. In such cases, in which the inflammation is mild and the exudation at a standstill or slow, the benefit from inhalations is most apparent. I am confident that one good result from alkaline inhalations is not fully appreciated by the profession: I refer to the fact that they render the muco-pus, which collects in large quantity in the bronchial tubes, and is expectorated with difficulty on account of its viscidity and the obstacle above it, thinner and more easily expelled.

Now that diphtheria has become so prevalent in this country, and so many children perish of the croup which it produces, it is to be hoped that some more efficient and at the same time unirritating substance may be discovered for inhalation than those at present in use.

Since my attention has been called to the fact by Dr. Van Syckel of New York that trypsin, one of the digestive ferments secreted by the pancreas, is a rapid solvent of fibrin, he having observed its action in the laboratory of Prof. Kühne of Heidelberg, I have employed this agent in the usual form of diphtheria in several instances with such result as to encourage the hope that the solvent which we have so long needed has been found. I have never seen pseudo-membranes disappear from the fauces more rapidly than in cases in which the following mixture was applied every half hour with a large camel's-hair pencil, whether the good effect was due to the trypsin contained in the extract or to the alkali, or to the combination of the two:

Extracti pancreatis (Fairchild's),	ʒj;	
Sodii bicarbonat.,	ʒiij.	Misce.

Add one teaspoonful of this to six teaspoonfuls of water.

Thus recently, in a child of about five years a thick pseudo-membrane over each tonsil had disappeared by the third day, without apparently any irritating effect from the application. Mr. Fairchild has recently prepared trypsin in a liquid form in order that its efficacy can be more readily and conveniently tested as a solvent for the membranes in croup; and different observers state that this liquid employed in spray has in certain cases exerted a marked solvent action on pseudo-membranes. Additional clinical observations will determine the value of trypsin as a solvent. That it requires an alkaline medium for its activity renders it compatible with alkaline inhalations, as we have stated above.

Internal Treatment.—Calomel.—This was long regarded as the most important internal remedy for membranous croup, as well as for diphtheritic exudations elsewhere than in the larynx. In the belief that it had a tendency to prevent the formation of pseudo-membranes, and aided in detaching and removing those already formed, it was in common use until about twenty-five years ago. It was sometimes prescribed for croup in large doses, but more frequently in doses of one-half, one, or one and a half grains, repeatedly every second or third hour, and often in combination with an opiate, as Dover's powder. However useful a remedy it may be when judiciously employed in croup as well as in certain other diseases, it fell into disuse on account of its ill-advised use in diseases which did not require it, often to the extent of producing unpleasant and even dangerous symptoms. When diphtheria was established in this country calomel was in a few years discarded by most physicians as a remedy for croup, on account of the growing belief that nearly all cases of this disease were local manifestations of diphtheria and required less depressing and more sustaining measures than mercury. Moreover, it was easy to point out cases in the writings of such masters of the profession as Bretonneau and Trousseau in which calomel was improperly employed, doing harm by causing not only severe salivation, but also gangrene. Nevertheless, cases occurred in those days which seemed to show that this agent, properly employed, is a potent and useful remedy for croup. One in the Astor House of New York attracted attention. A child of about two years stopping at this hotel had pseudo-membranous laryngitis, with constantly increasing dyspnœa. Prominent physicians summoned to him expressed the opinion that he could not live, when, through the advice of a physician from an inland city who was temporarily sojourning in the hotel, twenty grains of calomel were placed on his tongue. From this time the dyspnœa began to abate and the patient recovered.

The medical journals from time to time have published reports of cases of croup in which calomel has apparently been beneficial. Dr. J. P. Klingensmith[1] of Blairsville, Pennsylvania, states that physicians in his locality prescribe calomel in large doses for croup, and with greater success than that achieved by other modes of treatment, and he relates three cases showing the result in his own practice:

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[1] *Med. Record*, July 12, 1884.

CASE.—A child aged twenty-eight months took twenty grains of calomel placed on the tongue in the commencement of croup, and afterward ten grains every hour till the third day, when seven hundred and twenty grains had been taken. It was now discontinued, and on the sixth day the pseudo-membranes had disappeared. Recovery was rapid and without any untoward symptoms.

CASE.—The second patient, aged three and a half years, had been sick forty-eight hours, with a temperature of 102° F. He had a croupy cough and a pseudo-membranous exudation. Twenty grains of calomel were administered, and afterward ten grains, every hour for fifteen hours, so that one hundred and seventy grains were administered. The child, which had previously been restless, fell into a quiet, natural sleep. The calomel was discontinued, and a mixture of potassium chlorate and ammonium chloride given in its place. On the fifth day convalescence was fully established without any unfavorable symptoms.

CASE.—The third patient, a girl of four years, had been sick twenty-four hours, with "high temperature, painful croupy cough, labored respiration, dry skin, flushed face, and some diphtheritic" exudation. Twenty grains of calomel were administered, and followed by hourly ten-grain doses till twelve doses were given. No other remedy was employed, and in three or four days the patient recovered.

These appear to have been genuine cases, and that they recovered tends to confirm the belief that calomel does exert a beneficial action on pseudo-membranous inflammations, either diminishing the exudation or promoting the liquefaction and detachment of the pseudo-membrane.

A mode of treatment commonly accepted and practised by the profession through a long series of years usually does some good, in at least a certain portion of cases, even if it be abused, else it would not be likely to gain general acceptance. We know how quickly calomel cures the mucous patches of syphilis even when they are of large size. These are produced by inflammatory changes in the tegumentary system, and they consist largely of epithelial or epidermic cells. They therefore contain elements similar to the pseudo-membrane in croup, but without the fibrin. We know also how readily fibrinous opacities on the cornea yield to calomel dusted on them. We may admit that calomel probably exerts a salutary action either on the exudative process or the pseudo-membrane, without being able to state precisely how it acts. Bouchut says of calomel in his article on croup: "This medicine promotes the expectoration and the rejection of the false membrane." Trousseau believed that the beneficial effects of the mercurial preparations were due mainly to their local action. He states that "wherever they can be applied locally" they "modify most powerfully the diphtheritic inflammation." He dusted the inflamed surface, if accessible, with calomel or with a powder of the red precipitate, one part to twelve of pulverized sugar. The use of the mercurial collar for the neck in the treatment of croup, employed and recommended by Bretonneau, is familiar to those who have read his memoirs. Professor Jacobi also, who has probably given more attention to diphtheria than any other physician in America, apparently believes that mercury used locally is beneficial in croup, for he has recently recommended inunction with the oleate of mercury upon the neck whenever the bichloride of mercury administered internally disagrees. It has seemed to me that one or two large doses of calomel administered in the commencement of croup, when there is no decided cachexia, do exert a beneficial action on the course of the disease, as in the following case:

CASE.—R——, male, aged three years, began to be croupy, but without any marked impairment of the voice, on November 7, 1884. The mother states that he has had sore throat nearly one week, but without medical attendance. His respiration gradually became more noisy and difficult till the evening of the 8th, when I was asked to see him.

His temperature was 99°. The dyspnœa was such that the post-clavicular, suprasternal, and inframammary regions were depressed on inspiration, and his breathing was noisy, but the voice had nearly the usual clearness. The fauces, though red, were not notably swollen, and a pseudo-membranous patch of the size of the little finger-nail lay over the right tonsil. The diagnosis was therefore made of mild diphtheria, but with dangerous laryngeal stenosis, probably from the presence of a pseudo-membrane; general condition of the child good. Six grains of calomel were placed on the tongue, and inhalation was ordered by the steam-atomizer of the following:

℞. Liquor potassæ, ℥j;
Aquæ calcis, Oj. Misce.

The record of November 10th states: Resp. 38 per minute, still noisy, but no increase of dyspnœa; pulse 126; temperature in groin 99¼°; slight discharge from nostrils; uses the inhalation almost constantly. From this date the pseudo-membrane and redness of the fauces gradually disappeared, and two days later the patient was out of danger.

The results of the treatment of diphtheria and of the inflammations which accompany this disease are liable to produce an erroneous opinion in regard to the value of therapeutic agents, since cases differ so greatly in type or severity. But the experience of many physicians justifies the belief that mercury, and especially calomel, employed within certain limits in the commencement of a pseudo-membranous inflammation, does exert some controlling action on this disease. That it did much harm formerly, when physicians prescribed it freely to the extent in many instances of increasing the cachexia and causing mercurialism, should not deter from its judicious use. In the ordinary form of diphtheria I would not advise the use of calomel, or would limit its employment to one or two doses of six or ten grains in the commencement of the disease in robust cases. But in croup, since the danger is not from the cachexia or blood-poisoning so much as from the laryngeal stenosis which usually develops rapidly, that medicine is indicated, and should be prescribed, which most strongly retards the exudative process and aids in liquefying and removing the pseudo-membrane; provided that it produce no deleterious effect which renders its use inadmissible. Hence it is proper to prescribe calomel in larger doses and for a longer time in the treatment of croup than in other forms of membranous inflammation, if it fulfil the indication, as it seems to in a measure. In my own practice, however, calomel is not prescribed after the first or second day, since I prefer the use of other remedial measures which are efficient and are less likely to produce injurious effects. It is certainly the opinion of the majority of New York physicians, in which I concur, that after the first day corrosive sublimate is preferable to other forms of mercury for internal use, inasmuch as most cases of membranous croup occur as a manifestation or complication of the microbic disease diphtheria.

Emetics.—These have been largely used in all forms of croup, and in catarrhal or spasmodic croup they usually produce marked relief. Formerly, emetics were much employed in the treatment of membranous croup, but now that diphtheria has spread throughout the country, and most cases of this form of croup occur in patients suffering from diphtheritic blood-poisoning, depressing emetics, as ipecacuanha and antimony, have fallen into disuse, since they were found to be badly tolerated. In my practice a child of ten years with severe diphtheria and with commencing croupy symptoms sank rapidly and died between two of my visits, from exhaustion produced by a single large dose of ipecacuanha administered by anxious parents without my advice.

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But an emetic gives partial relief to the dyspnœa in certain cases, since it assists in expelling the muco-pus which blocks up the tubes below the pseudo-membranes, and sometimes portions of pseudo-membrane, which are easily detached. If an emetic be employed, one should be selected which acts promptly with little depression, and as a rule it should, I think, only be used at the commencement of croup. If after the initial period there be that degree of dyspnœa which suggests its use, intubation is preferable as more likely to give relief and save the patient. Of the emetics which are admissible in the commencement of croup, sulphate of copper is one of the best. Several years since, in one case in which there were at my first visit dyspnœa, croupy cough, and a pseudo-membrane over each tonsil, and in regard to which I had made an unfavorable prognosis, the parents, observing the good effects of two grains of sulphate of copper, repeated the dose every two to four hours till the following day, and the patient recovered. Such a result, however, I regard as exceptional. Probably in ordinary cases the best emetic is the yellow sulphate of mercury or turpeth mineral in a powder of two or three grains. The use of this emetic in croup was prominently brought to the notice of the profession by Prof. Fordyce Barker, who administered this agent immediately after being summoned to a case, and, he alleges, with remarkable benefit to his patient. It has, however, been recently stated on apparently good authority that turpeth mineral, when it enters the stomach, although it causes vomiting, is not itself ejected unless in small quantity, so that a considerable part of its action may be through its absorption, its mode of action being like that of calomel.

Internal Disinfectants or Germicides.—The theory which happens to prevail regarding the nature of a disease necessarily influences the treatment. The theory is now accepted that diphtheria is produced by a microbe, and hence the use of antiseptic internal remedies is proper in the treatment of croup when it supervenes as one of the manifestations of diphtheria. Therefore the most active of the germicides, corrosive sublimate, is commonly employed in New York, as we have stated above, in the treatment of diphtheritic croup, in the same manner as in other forms of diphtheria.

Since membranous croup in localities where diphtheria prevails is in most instances a local manifestation of this disease, the same sustaining general treatment is required which is proper in ordinary cases of diphtheria. The tincture of the chloride of iron, administered every second hour in liberal doses, potassium chlorate, quinine, brandy or other form of alcohol in large and frequent doses, long used in diphtheria as tonics and blood-restorers, are indicated. Medicines of this kind may be given between those which are designed to correct the exudative process and aid in removing the laryngeal obstruction, which have been described above. The diet should be nutritious and easily digested, consisting largely of milk and the meat teas. For those with poor appetite and feeble digestion peptonized milk and the peptonized meat juices may often be advantageously prescribed.

Surgical Treatment.—Although the best possible treatment by inhalations and internal medication be early employed and without intermission, yet it is the common experience in all countries that such treatment is in a large proportion of cases inadequate, and that many perish from suffocation unless relieved by surgical interference. We have stated above that if croup occur at the commencement of diphtheria, when the exudative process is active and the pseudo-membranes form rapidly and abundantly, death is the common result if the medicinal treatment only be employed. But if the inflammation be less intense or subacute, as in the second week in diphtheria, so that there is more time for the action of medicines and inhalations, and if, as is sometimes the case, the stenosis appear to be at a standstill, without any marked suffering from want of air, resort to surgical measures may be judiciously postponed.

The indications for surgical interference are a gradual increase of the stenosis and consequent dyspnœa, notwithstanding the constant and judicious use of remedial agents, and a manifest suffering from want of air as shown by restlessness of the child and the expression of suffering in his features, with or without lividity of the surface. We adults may have some faint conception of the suffering which children with acute laryngeal stenosis undergo when we have severe nasal catarrh and attempt to breathe with the mouth closed; and the paramount duty of the physician to relieve suffering should prompt to a resort to other measures when medicines prove inadequate, even if we leave out of account the important object of saving life. When, therefore, membranous croup is found to be progressive after having been observed and properly treated from six to twenty-four hours, and the child begins to suffer from want of air, the propriety of surgical measures should be considered.

CHAPTER IV.

INTUBATION.

THE most important improvement made in recent years in the treatment of croup is intubation, for which the profession are indebted entirely to the genius and perseverance of Dr. Joseph O'Dwyer. Intubation is destined in the future to prevent an immense amount of suffering in the various forms of laryngeal stenosis. It has rescued, and will rescue, multitudes of children from a most painful death by suffocation. It is an operation of remarkable simplicity, quickly performed, without the use of anæsthetics and without pain to the patient. In this respect it contrasts strikingly with laryngotomy or tracheotomy, which is a painful and bloody operation, and which, for its proper performance, requires more or less delay. Those who have witnessed the slow suffocation of children in membranous croup and catarrhal croup when accompanied by œdema and infiltration can best appreciate the value of intubation.

In 1858, Bouchut published a paper on the treatment of croup by intubation of the larynx. He employed a straight cylindrical tube nearly an inch long. The tube was introduced by means of a male catheter open at its two ends. Intubation excited some attention and discussion at the time in the Parisian capital, and M. Gros related a case of its successful employment. But, performed with such rude instruments, it met, as might be expected, with strong opposition from the first by such men as Barthez and Trousseau, who were bringing forward tracheotomy, and it soon fell into disuse and was forgotten. It was reserved for American surgery to achieve the honor of its successful employment. Dr. O'Dwyer, wholly ignorant of the previous history of intubation, after many measurements of the larynx of the cadaver, many discouragements, and many modifications in the tubes to facilitate their introduction and retention, has so improved them that the objection to their use strongly urged by Trousseau thirty years ago, that they caused ulceration, is inapplicable to the tubes now in use. Dr. O'Dwyer has kindly contributed the following paper descriptive of this operation:

INTUBATION.

BY JOSEPH O'DWYER, M. D.

In the following pages I will confine myself to the practical details of this operation, as applicable to those forms of stenosis of the larynx that occur almost exclusively in children. The reader is referred to the appropriate sections of this book for information in regard to the diagnosis, medical treatment, etc. of croup and kindred diseases.

A very serious impediment to the success of intubation, and one for which there is no remedy, arises from the large number of grossly-imperfect instruments that are constantly being made and sold as the latest improvements. I will therefore first endeavor to point out some of the grosser defects referred to, in order that every one who uses these tubes may be able to distinguish the good from the bad.

The most common defect, and at the same time the one attended with the most serious consequences, is apparently so insignificant that it is often overlooked by the manufacturers, even after their attention has been repeatedly called to it. It results from filing the metal so thin on the anterior surface of the distal extremity as to produce a cutting edge at this point. It should be remembered that this part of the tube is not only in contact with the anterior wall of the trachea, but that it also moves up and down over a space of about half an inch during every act of swallowing. This position is produced by the backward pressure of the base of the tongue, which pushes the epiglottis and the upper extremity of the tube before it with considerable force, tilting the lower extremity forward, which glides upward as the larynx is raised and the trachea stretched, to fall back to what may be called its respiratory position as soon as the act of swallowing is completed.

If sharp, or even in the slightest degree rough, at the point indicated, a proportionate degree of injury will be inflicted on the mucous membrane, sometimes amounting to a deep ulcer, which adds to the danger of systemic infection and gives rise to painful deglutition and bloody expectoration.

In the perfect tube the metal on the anterior surface is left quite thick and smoothly rounded off like the runner of a sled, so that it will glide up and down over the tissues without injuring them. As the distal extremity of the tube seldom impinges on the posterior wall of the trachea, and never touches the sides, the metal at these points should be comparatively thin, to avoid increasing the size, but the whole should form a perfectly smooth probe-point when the obturator is in position. If the obturator do not project far enough beyond the end of the tube, or if it fit imperfectly, the sharp edges will be left unprotected, which will injure the tissues while passing through the narrowed glottis.

The metal is also left thick on the anterior surface of the upper extremity in order to prevent the formation of a cutting edge under the epiglottis. The head or shoulder of the tube which rests in the vestibule of the larynx, and which is compressed by the action of the constrictor muscles in every act of swallowing, should be absolutely free from any roughness or projecting angles or edges. This portion of the tube, about a quarter of an inch in length, has a backward curve to carry it away from the base of the epiglottis, where a perfectly straight tube would be liable to produce ulceration.

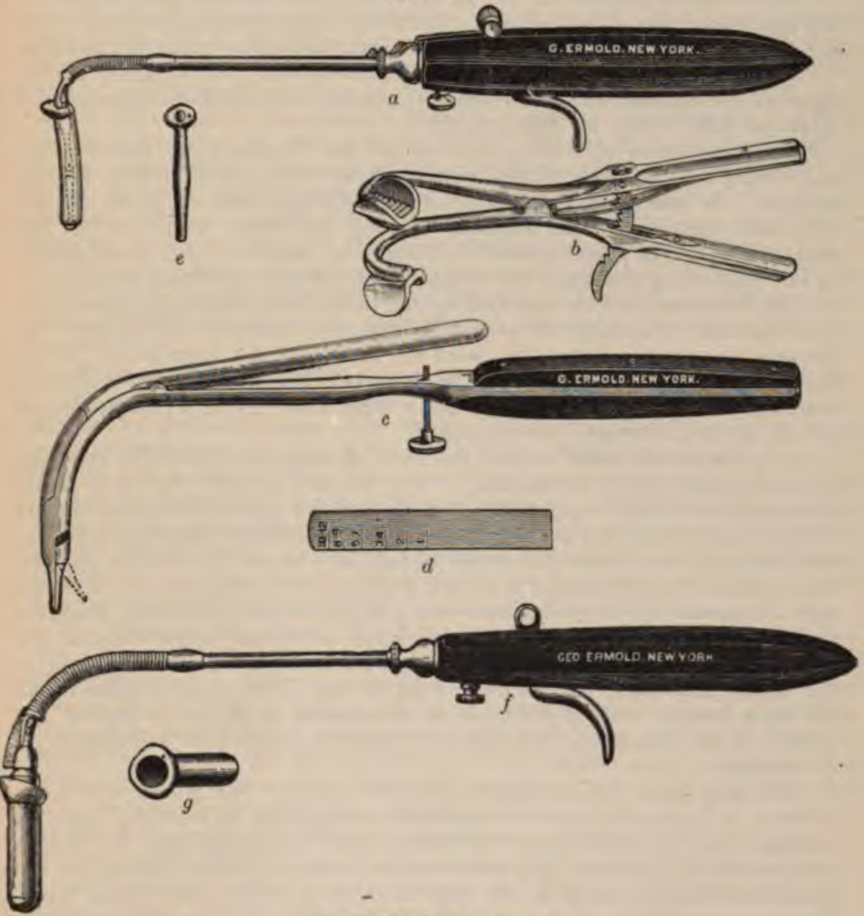
Another very common defect is the imperfect fitting of the obturator, which allows the tube to wabble when attached to the introducer, and causes it to slip off if the operation fail to place it in the larynx on the first attempt. The instrument-makers find it very difficult to overcome this defect, owing to the joint in the shank of the obturator and the backward curve that exists in the upper portion of the tube.

If properly made, the tube when attached to the introducer and ready for use should be as free from motion as if constructed of one piece.

I have also noticed in many of the sets of instruments otherwise imperfect that the lines indicating the years on the scale do not correspond to the length of the tubes, which renders it difficult for a beginner to select the proper size. By observing the following rule the scale can be dispensed with: The smallest size is suitable for the first year of life, the second for the second year, and the third size for from two to four years, and the others for two years each.

A set of intubation instruments suitable for children up to the age of puberty consists of six tubes (*e*), an introducer (*a*) and extractor (*c*), a mouth-gag (*b*), and a scale of years (*d*); *f*, introducer and tube; *g*, a large round tube used for the expulsion of membrane. Each tube is supplied with a separate obturator, one end of which screws on to the introducer, while the other extends sufficiently beyond the distal extremity

[1] FIG. 41.



Intubation Instruments.

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[1] Geo. Ermold, 204-206 East Twenty-third Street, New York.

of the tube to convert the whole into a probe-point. The numbers on the scale represent years, and indicate approximately the ages for which the corresponding tubes are suitable. For example, the smallest size when applied to the scale, including the head or shoulder, will reach the line marked 1, and is suitable for the first year of life, but may be used up to fifteen or eighteen months if the child be small for its age.

The next size, which reaches the line marked 2, is intended for children between one and two years, but may be used up to three years, the only objection being that it is liable to be coughed out. The third size, marked 3–4 on the scale, should be used between the ages of two and four years; and so on.

The largest tube in the set may be used in the early years of adolescence by having a string attached, but is of no use in the adult larynx, as it would either be expelled immediately or pass through into the trachea.

When the proper tube for the age is coughed out, there is always room for the next larger size. In one case, of an infant aged twenty months, in which the two-year-old tube was twice expelled, I was obliged to insert the 3–4 size.

Indications for Intubation.—As the indications for this operation are the same as for tracheotomy, the reader is referred to the proper section of this work for information on this subject.

Method of Operating.—A tube of proper size for the age is first selected, and strong silk or linen thread passed through the eyelet intended for this purpose. In case the tube is placed in the œsophagus instead of the larynx, it quickly passes into the stomach, drawing the string with it, unless the latter be held. To guard against this accident, therefore, the thread should be left long enough to reach the stomach and still protrude from the mouth.

The obturator is then screwed tightly to the introducer and passed into the tube when it is ready for use. The antero-posterior or long diameter of the tube should then be in a line with the handle of the introducer. If the obturator be found to turn too far to bring it in this position, which usually occurs after having been used for some time, a washer of writing-paper of one or more thicknesses can be added.

It is always advisable to push the tube off once or twice before inserting it, to be certain that it works easily. The person who holds the child should be seated on a solid chair with low back, and the patient placed on the lap with its head resting on the left shoulder of the nurse, to avoid interference with the gag. The hands may either be held or secured by the sides by passing a towel or napkin around the body, and retained in that position until the tube is inserted and the string removed. Failure to pay particular attention to this precaution is often the cause of much annoyance to the operator, for if the child gets its hands free for an instant, it seizes the thread and removes the tube. Fastening the hands in front of the chest or thick garments in the same location are objectionable, as they render it difficult to depress the handle of the introducer sufficiently to carry the tube over the dorsum of the tongue.

The gag should be inserted in the left angle of the mouth, well back, between or behind the teeth if practicable, and opened as widely as possible without using too much force. In children who have not at least one double tooth on the left side the gag should not be used, as it slides forward on the gums, and, besides being in the way, is likely to injure the incisor teeth. There is little difficulty in keeping the mouth sufficiently open with the finger, and no danger of being bitten if it be kept well to the patient's right. The necessity of using force is obviated by allowing the child to compress the finger for a few seconds until the jaws relax, before carrying back into the pharynx. The Denhard gag, which is shown in the cut, holds better than the one originally devised by the author, and seldom slips if properly placed.

An assistant, standing behind, holds the head firmly by placing one hand on either side, and, if without experience, should be requested not to touch the gag. The operator, either standing or sitting in front of the patient, the former position being preferable, holds the introducer lightly between the thumb and fingers of the right hand, with the thumb resting just behind the button that serves to detach the tube, and the index finger in front of the trigger-support underneath. Held in this position, it is impossible to use force enough to make a false passage, while if firmly grasped in the hand the beginner is very liable to lacerate the tissues.

The index finger of the left hand is now quickly passed well down in the pharynx or beginning of the œsophagus, and then brought forward in the median line, raising and fixing the epiglottis, while the tube is guided beside the finger into the larynx.

If any difficulty be experienced in feeling the epiglottis, it is better to seek the cavity of the larynx, a cul-de-sac into which the tip of the finger readily enters, and which cannot be mistaken for anything else. Once in this cavity, the epiglottis must be in front of the finger, and the latter is then raised and carried to the patient's right in order to leave room for the tube to pass beside it. As the larynx contracts when touched, thereby diminishing its aperture, it is necessary to keep the distal extremity of the tube close to the finger, or even directing it a little obliquely to the right in order to get inside the left aryepiglottic fold. This is particularly important in very young children, in whom the tip of the finger completely covers the larynx.

In the beginning of the operation the handle of the introducer is held close to the patient's chest, and rapidly raised as the lower end of the tube passes behind the epiglottis; otherwise, it slips over the larynx into the œsophagus.

When the tube is inserted, it is slipped off by pressing forward the button on the upper surface of the handle with the thumb, while counter-pressure is made by the index finger underneath. In removing the obturator the tube must be held down by placing the finger either on the side or posterior portion of the shoulder. The tube should be carried well down before being detached, otherwise it is liable to become occluded with false membrane when subsequently pushed home with the finger. When the tube is in place the gag is removed, but the string is allowed to remain for about ten minutes, or until it is ascertained with certainty that the dyspnœa is relieved and that no loose membrane is present in the lower portion of the trachea.

In removing the thread the finger must be reinserted to hold the tube down, but the reinsertion of the gag is rarely necessary for this purpose. The extraction of the tube is much the most difficult operation, and at the same time the most dangerous as far as injury to the larynx is concerned. The patient is held in the same position as for insertion, and the extractor is guided along beside the finger, which is first brought in contact with the head of the tube, and then carried to the right in order to uncover the aperture and leave room for the instrument to enter beside it.

Before inserting the extractor it should be ascertained with certainty that the tube is still in the larynx. This can be determined by the tubal character of the cough, which is characteristic, the difficulty of swallowing, and, lastly, by the sense of touch if necessary.

Difficulties of the Operation.—Few who have not practised intubation recognize the fact that it is a difficult operation to perform, and that it is difficult simply because it must be done quickly and at the same time gently. Sufficient dexterity to fulfil both of these requirements can only be acquired by a great deal of practice, and if this be gained on the living subject it must be at the expense of a great deal of unnecessary suffering and the sacrifice of many lives as well. It is the sense of touch alone that is to be relied upon, and that requires to be educated; consequently, the accomplished laryngologist who has only educated his sense of sight is no more competent to perform the operation than one who has never seen the larynx in its normal position.

The operator has so many movements to make, involving both hands, in such a brief space of time, that unless he have had sufficient practice to make some of these movements to a certain extent automatic, he cannot operate with safety to his patient nor with credit to himself. The epiglottis must be found, raised, and held in this position as the tube is glided down in contact with the finger, otherwise the operator does not know where it is; it has to be slipped off at the right moment, and held down while the obturator is being removed; and to be safe all these movements must be completed in less than ten seconds.

Intubation should therefore never be attempted, except in case of emergency, without some preliminary practice, either on the cadaver, on one of the smaller animals, or on a larynx removed from the body. Let the beginner who has never performed either operation choose tracheotomy rather than intubation as being the safer, because in the former he can see what he is doing and his patient can breathe during the progress of the operation. Practice on a child's cadaver is within the reach of comparatively few, but it can be done on that of one of the smaller animals, such as a cat or dog, with practically the same result—viz. education of the sense of touch and automatism in some of the movements.

In addition to a moderate amount of this kind of practice, every young operator should keep a small larynx in preservative fluid on which he can continue to practise at frequent intervals by placing it upright in the neck of a bottle or other receptacle in the same relative position which it occupies in the body.

There is no doubt that dexterity in the use of these instruments can be acquired in this manner; and this is particularly important in extracting the tube, which is so difficult to do without injuring the larynx.

The difficulty sometimes experienced in intubating older children who offer resistance is to a great extent obviated by placing their legs between the knees of the person acting as nurse and holding them firmly in that position.

Accidents and Dangers of Intubation.—The most serious of the avoidable accidents attending this operation is asphyxia, from holding the finger too long in the throat. It should be remembered that when intubation is called for the patient is getting very little air, and can afford to dispense with this little only for a very short time without danger to life. After the insertion of the gag an expert can, as a rule, place a tube in the larynx in five seconds or less, and without any shock worth considering. The novice, on the contrary, having so many other things to occupy his attention, is very liable to forget how long his finger has been in the throat, and that during this time respiration is practically suspended. A fatal issue under these circumstances is almost invariably attributed to pushing down membrane, which is not a common accident, and has never proved immediately fatal in my hands.

There is seldom any danger from repeated failures to intubate, provided the finger be not retained in the pharynx longer than ten seconds at a time, and the child be given a chance to get its breath between the

It is well for the beginner always to have another physician present, who while holding the head will watch the patient closely and be prepared to give some prearranged signal to stop when he thinks there is danger of asphyxia.

The ventricles of the larynx seldom offer any obstruction to the entrance of the tube, as they are usually obliterated by the swollen mucous membrane and covered over by the fibrinous deposit in croup; but this should be remembered if any resistance be encountered, as it does not require much force to make a false passage at these points.

Pushing down a mass of pseudo-membrane before the tube is the most serious of the unavoidable accidents attending intubation in croup. In the majority of cases the offending membrane is expelled on the withdrawal of the tube, if the latter be inserted quickly and as quickly removed when the respiration is found to be suspended; and even if none be expelled the patient is in no worse condition than he was in before the operation.

I have devised and tried various instruments for the removal of pseudo-membrane from the trachea, but I have found short cylindrical tubes of large calibre the most successful. Being short, they do not accumulate masses of membrane before them, and, while overcoming the obstruction in the glottis, afford relief to the dyspnœa where the long tubes fail. They are only intended for temporary use, as, owing to their large size, extensive ulceration would result if long retained. The string should be left attached and secured behind the ear, by which the tube can be removed at the end of four or five hours whether any false membrane be expelled or not. The amount of dilatation from the pressure accomplished in this time will usually secure several hours of relief from dyspnœa and give ample time for the physician to reach the patient and reintubate, if necessary. Should the offending membrane still be retained, it is better to use the same tube on the recurrence of dyspnœa than to again run the risk of producing apnœa by inserting the long one; otherwise the latter is preferable.

These tubes (Fig. 41, *g*) have no retaining swell, the size alone being sufficient to retain them. The metal of which they are constructed is made very thin, in order to have as large a lumen as possible, and they can also be used to facilitate the expulsion of foreign bodies from the lower air-passages. Under these circumstances they can be left in position for a much longer time without danger from pressure, because the mucous membrane of the larynx is in the normal condition.

A separate introducer with long curve is necessary for these tubes in order to carry them well through the subglottic division of the larynx before removing the obturator.

Danger of Asphyxia from Loose Membrane below the Tube.—The existence of loose membrane below the tube—that is, in the lower portion of the trachea—usually gives rise to the following signs: A flapping sound with the respiratory movements, a hoarse or croupy character of the cough, and obstructed aspiration, especially when forced, as in the act of coughing. In some cases there is no difficulty while the breathing is quiet, but the egress of air is completely cut off with the first attempt at coughing. The *vis à tergo* thus developed is often sufficient to cause the expulsion of both tube and pseudo-membrane, but this does not always occur, and precautions should be taken to avoid the danger of sudden death from this cause.

The safest plan is to leave a string attached, by which any one who is present can remove the tube in case of threatened asphyxia. Should this not be practicable, owing to the age or from other causes, a smaller tube than that indicated by the scale of years should be used, which would be more likely to be coughed out in the event of its sudden occlusion. Either of these methods should be resorted to if the symptoms of loose membrane in the lower part of the trachea, absent at the time of operation, subsequently show themselves.

Premature expulsion of the tube seldom occurs when the proper size has been used, and is rarely attended with danger, provided the patient be within easy reach.

Dangers of Extraction.—Cases have been reported in which the tubes as now made, with large heads, have passed through into the trachea. This accident can only occur when the tissues of the larynx, cartilages included, have been extensively lacerated by the extractor by passing it down on the outside of the tube and withdrawing it with force. This danger has been minimized to a great extent by the addition of a regulating screw to the extractor, which prevents the blades from opening any wider than is necessary to hold the tube firmly.

No force is necessary to remove a tube from the larynx, and if any appreciable resistance be encountered, it is pretty certain that the instrument is caught in the tissues. Severe hemorrhage often results from a very moderate laceration produced in this manner.

When the Tube should be Removed.—In a large number of recoveries following intubation in croup the average time the tube was retained amounted to five days. The longest time in my own practice was twenty-nine days. The older the child, as a rule, the sooner it can be dispensed with. In very young children, when progressing favorably or if the patient be not within easy reach, it is better to leave it in position for seven or eight days. The frequent removal of the tube, unless specially indicated by a recurrence of the dyspnœa or for other cause, is bad practice, principally because of the irritation produced on each occasion. In protracted cases, in which the dyspnœa returns soon after the second or third removal at regular intervals of four or five days, it is safer to leave it in position continuously for two or three weeks, unless some special indication for its removal arises in the interim. If the tube be properly constructed and well plated, it will do no harm when retained for this length of time.

Management after Intubation.—One of the greatest advantages of intubation over tracheotomy is the fact that no skilled nursing is required after the operation. The most important part of the after-treatment consists in getting the patient to take a sufficient amount of nourishment. The difficulty heretofore experienced in this matter has been greatly reduced by the method suggested by Dr. W. E. Casselberry of Chicago. It consists in feeding while the patient's head is lower than the body. By this means advantage is taken of gravitation, thus allowing any fluid that may have entered the tube to escape without the act of coughing. The little patient soon learns this, and ceases to object to the uncomfortable position. For very young children at least the best position is lying on the back across the lap, with the head hanging well below the level of the body, and feeding from a spoon or bottle. Older children may be allowed to assume any position they wish, provided the head be lower than the chest.

Feedi [illegible] n the upright position should always be by spoon, at least for
[illegible] and the patient be given time and encouraged to
[illegible] swallowing. By this means any danger from the
[illegible] Nourishment in the solid and semi-solid forms
[illegible] than liquids—should be given the preference
[illegible] l to take them.
[illegible] ssary, but when resorted to should be given
[illegible] unces—and at intervals of three or four

No food or medicine should be given for two or three hours after intubation, unless the presence of the tube fail to excite sufficient cough to get rid of accumulated secretions. It is principally by the act of coughing that the tube is kept clear, and if this does not occur voluntarily, it may be excited by giving some irritating substance, such as carbonate of ammonia, brandy strong or slightly diluted, etc. If this plan be adopted and the air of the room be kept well saturated with warm vapor, it will rarely be found necessary to remove a tube for the purpose of cleaning it. The presence of a tube in the larynx does not contraindicate the use of an emetic, which is sometimes necessary when the bronchi are loaded with secretions.

TRACHEOTOMY.

Prior to the employment of intubation by O'Dwyer, tracheotomy was one of the most important operations in surgery. Properly performed and at the proper time, with judicious after-treatment, it has rescued many children from a most painful death. The details of this operation are given in surgical treatises, but some general remarks relating to it will not be inappropriate here.

Sanné says that the operator should have three assistants, at least one of them a physician. One should administer chloroform, one use the sponge, and the third, a physician, should be ready to assist in handing instruments, ligating vessels, etc. The operation is simple and devoid of danger, or difficult and dangerous, according to circumstances. The younger the child, the greater the danger, other things being equal. The greatest difficulty and risk attend tracheotomy in fleshy infants with thick and short necks and in patients who have extreme dyspnœa and are nearly moribund, so that the operator is compelled to hurry in the operation through fear that death will occur before the trachea is opened. The operator should have time for slow and cautious dissection, that he may avoid wounding vessels and other important parts.

The patient to be operated on should be placed on his back on a table covered by a blanket, and a bottle or block about four inches in diameter should be placed under his neck, so that the head is thrown back at an angle of forty-five degrees and the anterior surface of the neck rendered prominent. Chloroform is then administered. An incision should be made through the skin in the median line one and a half to two inches in length, according to the age, and extending to within half an inch of the sternum. Through the connective tissue to the trachea the dissection should be slowly and cautiously made with the point of the knife, the scissors, and the blunt hooks which are used to tear the connective tissue and draw aside vessels. The tip of the finger occasionally pressed upon the trachea aids in determining its location and serves to guide the dissection, which should always be in the median line. Little cutting is required after the skin has been divided, but when fibres of connective tissue resist the blunt hooks they should be cut either by the point of the knife or the scissors. A grooved director is also useful in the dissection, since by it the operator is enabled to raise and tear resisting fibres or detach them from parts underneath so that they can be more readily divided.

Some surgeons prefer the high, others the low operation. In the high operation the trachea is found nearer the surface, and the vessels in the way
ess numerous than in the low operation. In the operation, however, the
a is usually opened at that point, whether high or low, which is most
and laid bare. When this tube is exposed a longitudinal
through its anterior wall sufficiently long to allow the canula

to be inserted. To facilitate opening the trachea it may be held by a tenaculum constructed for the purpose, with the hook bent so as to be at right angles with the handle. The length of the incision through the trachea should be about five-eighths of an inch. The canula should not be immediately introduced, but the patient should be made to cough by inserting a pigeon's quill down the trachea into the bronchial tubes. Blood, muco-pus, and shreds of fibrin, if any be present, are expelled through the opening by the cough which the quill produces. The canula is now introduced, with or without the aid of the tracheal dilator. The one which is in common use is that devised by Trousseau, with some subsequent improvements. It consists of two concentric cylinders, the external fenestrated, and the disc or plate which supports the tubes is movable upon them.

The result depends to a great extent on the subsequent treatment. The common result is immediate relief to the dyspnœa, but unfortunately, in a large proportion of cases, the temperature rises about the third day after the operation and pseudo-membranes begin to form in the bronchial tubes, and in some instances broncho-pneumonia results. Surgeons have endeavored to prevent the formation of membranes in the bronchial tubes after tracheotomy by allowing lime-water to trickle through the aperture into the tubes. Perhaps some other solvent of pseudo-membranes, as bicarbonate of soda or trypsin, might be preferable for this purpose. No surgical operation more imperatively requires intelligent and attentive after-nursing than tracheotomy, since the canula needs to be frequently removed and cleaned whenever obstructed by muco-pus. No certain time can be foretold for the removal of the canula if the patient live. If on withdrawing the inner tube and applying the finger over the end of the remaining canula the patient breathe easily through the fenestra, the laryngeal stenosis has probably so far abated that the tube can be safely removed.

The following is a description of the instruments in the tracheotomy case of one of the most skilful operators in New York City, Dr. Fred. Lange; all of them have small handles like those of dental instruments:

1. *a.* A scalpel with cutting edge convex, the blade 1½ inches in length and its greatest width ½ inch. The scalpel is employed in dividing the skin and in subsequent dissection. *b.* A scalpel of same length, but with narrower blade and straight cutting edge, used for opening the trachea.

2. Two blunt hooks, with the hook straight, ¼ inch in length, extending at a right angle from the handle, having a diameter scarcely larger than a carpet needle. The end of the hook is slightly bulbous. A considerable part of the dissection is performed by the blunt hooks, which are used in tearing the connective tissue.

3. Three artery clamps, by which bleeding vessels or oozing surfaces are seized, and the instruments with their points attached to the bleeding surfaces are dropped upon the sides of the neck. They thus aid in drawing open the wound.

4. Tenacula: Two with hooks in line with the handle; two others with hooks at right angles to the handle; the diameter of the curves in the hooks ¼ inch. Those with hooks at right angles are employed for transfixing and holding the treachea when it is to be opened.

5. Two grooved directors, one with the end smaller and more pointed than that of the other.

6. A common artery-forceps, also forceps with fine teeth.

7. The spring hook of the oculist, employed by him in separating the eyelids; it holds apart the edges of the wound.

The tracheotomy-tube, consisting of two concentric cylinders, described

9. Pigeon's quills; these are important for removing muco-pus and fibrinous shreds from the trachea and bronchial tubes. An instance has come to my knowledge in which the physician who assumed charge of the case after the operation attempted to use for this purpose a small piece of sponge held by forceps; he unfortunately loosened his hold, and the sponge, drawn in with the breath, produced immediate death by suffocation. This would not have happened with the pigeon's quill.

When the operation is completed and the canula introduced, iodoform should be dusted upon the wound, and two thicknesses of linen soaked with the solution of bichloride of mercury, 1 part to 2000, notched so as to surround the canula and pass under its plates, should be applied over the wound, and every hour moistened with the bichloride solution. With such treatment the wound preserves a healthy appearance and heals readily.

CHAPTER V.

BRONCHITIS.

INFLAMMATION of the bronchial tubes, or bronchitis, is probably the most frequent disease of early life. It is usually associated with more or less inflammation of the mucous membrane of the nostrils, larynx, and trachea. We designate the disease coryza, laryngitis, or bronchitis, according as one or the other inflammation predominates. Sometimes bronchitis occurs with but slight inflammation elsewhere, and often the coryza and laryngitis abate while the bronchitis is still active.

Bronchitis occurs both as a primary and secondary disease. The secondary form is common in connection with measles, whooping cough, pneumonia, and pulmonary phthisis, and it is not uncommon in remittent and continued fevers. Bronchitis is acute, subacute, or chronic, and according to its extent it is mild or severe. If the smallest bronchial tubes are involved, the inflammation is designated capillary bronchitis—a term not well chosen, but which is conveniently employed in a description of the malady. Bronchitis is commonly bilateral, affecting the tubes on the two sides with about equal intensity. When due to tubercles or to pneumonia it is often unilateral, being confined to those tubes or nearly to those which lie in the tubercular or inflamed pulmonary tissue.

CAUSES.—The causes of secondary bronchitis are obviously the diseases in connection with which it occurs. The cause of primary bronchitis is the same as that of simple acute laryngitis or coryza—namely, sudden change of temperature from warm to cold, exposure to currents of air, the practice of sending children without sufficient clothing from heated rooms into the open air, the throwing off of bedclothes at night, etc.

ANATOMICAL CHARACTERS.—In the most common form of bronchitis the larger bronchial tubes only are affected. They are the seat of the inflammation in most of those cases which are designated "colds" by families, and which are often treated without the aid of the physician. The lining membrane of the bronchial tubes presents the ordinary anatomical characters of mucous inflammations. It is reddened uniformly or in patches, intensely or in that milder degree known as arborescence, according to the severity of the inflammation.

The secretion of the muciparous follicles is at first arrested and the surface of the membrane is dry. In the course of a day or two the secretory function is re-established, and the surface is covered with thin and transparent mucus. A day or two later the secretion becomes thicker, consisting of mucus and pus. Mixed with these substances are epithelial cells, which are exfoliated in abundance from the inflamed surface. At the same time the mucous membrane becomes thickened and more or less softened. If the inflammation be severe the vessels of the submucous connective tissue are also injected.

Usually, in about a week in the young child, in from one to two weeks in older children, the inflammation begins to abate. Gradually the inflamed membrane returns to its normal consistence, thickness, and vascularity, and with this return to the healthy state the muco-purulent secretion abates.

In this, which is the simplest and most common form of bronchitis, there is no ulceration, and rarely any pseudo-membranous formation if the disease be idiopathic. Pseudo-membranous bronchitis is not unusual as an accompaniment of pseudo-membranous laryngo-tracheitis.

Were bronchitis limited to the larger bronchial tubes, it would indeed be a simple affection, but, unfortunately, it has a tendency to extend downward. Commencing in the larger, it gradually invades the smaller tubes in a similar manner to the extension of erysipelas upon the skin. More rarely the inflammation commences simultaneously in the larger and smaller tubes. The gravity of bronchitis is proportionate to the degree of its extension downward. It may stop at any point in its progress, but if it reach the smaller tubes it is one of the most serious affections of early life.

The mucous membrane of the minute tubes, those next to the air-cells, is delicate, with but little submucous connective tissue, and it frequently, at post-mortem examinations, does not present to the eye those distinct inflammatory changes which are observed in tubes of large diameter. It is sometimes not notably thickened nor its vascularity much increased, even when there is reason to believe from the symptoms that it was the seat of active phlegmasia. As we pass from these minute tubes to those of larger calibre the inflammatory lesions become more distinct. The inflammation produces minute and abundant points of redness and the membrane is evidently thickened; often it is rough or granular.

The minute bronchial tubes are very small, especially under the age of three years, and, since in capillary bronchitis a large proportion of them are inflamed, the source of the danger is apparent. It is with difficulty that the patient with capillary bronchitis can by the effort of coughing free the tubes from the secretions which are constantly collecting in them. In weakly children under the age of two years expectoration is most difficult, and hence the great and increasing dyspnœa from which such patients suffer.

In severe and unfavorable cases of bronchitis, which are chiefly those in which the small as well as large tubes are inflamed, the following anatomical changes commonly occur: The muco-purulent secretion, which is tenacious, collects more rapidly in the smaller tubes than it is expectorated by the child, whose strength begins to be exhausted. The accumulation of the secretion is chiefly in the tubes which lie in the posterior and inferior portions of the lung. As the obstruction from the muco-pus increases in these tubes, less and less air passes through them into the alveoli, with which they communicate, while the quantity of air which passes through the unobstructed tubes into the anterior and superior portions of the lung is proportionately increased. The effect, as regards the state of the lung, is obvious. In cases having a fatal issue, and in which we are therefore able to inspect the lesions, we find that the lower and inferior portions of the organ, from which air was to a greater or less extent excluded, have a diminished crepitation; that they lie a little below the general level, or that certain lobules do; and that they present a congested appearance, for while they contain too little air, they have an excess of blood. We shall also find that the upper and anterior parts of the organ, perhaps the entire upper lobe, contain more than the normal quantity of air, so as to rise above the general level. There is distension of the alveoli in these parts, so that they are probably visible to the naked eye, and may appear to be emphysematous; but this is a state distinct from emphysema. It is merely an inflation of the alveoli to nearly their full capacity.

Here and there in the portion of lung in which the inflation has been incomplete, lobules may be observed which are entirely collapsed, having a dusky-red color and no crepitation; while in other parts, if the bronchitis have continued some days, there are nodules of pneumonia. Often when the bronchitis is severe the inflammation, commencing in the bronchial tubes, extends to the lungs, usually to lobules, in the lower lobes, constituting broncho-pneumonia. The occurrence of pneumonia is announced by an aggravation of symptoms, and frequently by the expiratory moan. The incised surface of those portions of the lung to which the access of air has been prevented, whether they are collapsed fully or partially or not, has a reddish color from congestion and is moist from serum and blood. On compressing the lung the muco-purulent secretion appears upon the surface in points, having escaped from the divided ends of the tubes. (For other facts relating to atelectasis the reader is referred to the chapter in which this malady is described.)

Exceptionally, even when not accompanied by laryngeal croup, fibrinous exudation occurs in the bronchial tubes, forming a delicate film here and there, and readily detached from the surface underneath, while in rare instances it occurs as a firm and continuous membrane, forming a mould of the tubes, increasing greatly the dyspnœa constituting a true bronchial croup. If the patient with severe bronchitis survive, the inflammation of the mucous membrane soon begins to abate. The tubes which have been the seat of the disease and the alveoli which have been secondarily involved may return to their normal state almost immediately; but in other instances such anatomical changes occur in them, even when there is no pneumonia nor atelectasis, that full restoration to their normal state is necessarily somewhat slow. When the function of a lobule ceases, as it does when the tube leading to it is obstructed, not only hyperæmia occurs, with or without collapse, as already stated, but its cells and nuclei, and perhaps other parts, begin to undergo fatty degeneration. These elements become granular, somewhat enlarged and opaque, and here and there mixed with them are other large cells filled with oil-globules. These are the compound granular cells of pathologists, and, occurring in this situation, are produced by metamorphoses of the epithelial cells. They are epithelial cells which have progressed more rapidly than others in fatty degeneration, having reached that stage of it which immediately precedes liquefaction. We often with the microscope observe not only these corpuscles, but their fragments as they are dissolving.

Minute abscesses, usually directly under the pleura, have occasionally been observed at the autopsies of those who have recently had general bronchitis, and pathologists are not agreed as to the mode in which they are produced. Some of them, if not all, are evidently connected with the minute bronchial tubes, and the quantity of pus contained in each is not usually more than one or two drops. The most reasonable view of their causation is that they are produced in the terminal tubes where the mucus and pus collect. The pus acts as an irritant and causes inflammation, and the inflammation increases the quantity of pus. The walls of the tube which is now the seat of an abcess are destroyed by ulceration, and probably also some of the contiguous air-cells. The little cavity is soon surrounded by a delicate membrane, the same in character, though less thick and firm, as that which constitutes the walls of larger abscesses. The pus presents the usual appearance of this liquid, or it may be tinged by the presence of blood-cells, or, again, it may be thick from partial absorption of the liquor puris so as to resemble softened tubercle.

The abscess is ordinarily located in the centre of a collapsed lobule. In certain cases it approaches the surface of the lungs, so as to produce circumscribed pleurisy, with adhesion of the costal and visceral pleura. At the autopsy of such a case, on separating the adhesions and attempting insufflation the air passes through the aperture, so that the lung on that side cannot be inflated unless the aperture be closed. Occasionally pneumothorax results from opening of the abscess into the pleural cavity.

In severe protracted bronchitis dilatation of certain of the bronchial tubes sometimes results. The alveoli in the upper lobes may also be distended beyond their physiological capacity, so as to produce emphysema, but, as we have stated above, their maximum distension within physiological limits must not be mistaken for emphysema. Emphysema in the upper lobes is common in feeble young children with relaxed and weakened tissues, occurring even without any severe disease of the respiratory organs. It may be vesicular or interstitial. If it be interstitial, the sacs of air often attain considerable size, lying as wedges between the alveoli or like little bladders upon the surface of the lung. It is not difficult to understand how emphysema occurs in severe bronchitis, since the air partly arrested in the tubes leading to the lower lobes enters the upper lobes in increased volume and force.

SYMPTOMS.—It is evident, from the description which has been given of the anatomical characters of bronchitis, that its symptoms vary greatly in severity in different patients. It usually commences with more or less coryza. The symptoms are headache, flushed face, elevation of temperature, acceleration and fulness of pulse. In the mildest cases these symptoms are scarcely appreciable. The child is observed to sneeze and have some defluxion from the nostrils, and this is followed by an occasional mild, almost painless cough, which declines in the course of a few days. The respiration and pulse are scarcely accelerated and the appetite is but slightly impaired. There may be a little fretfulness, but the child is not confined to his bed or room and usually amuses himself with his playthings. Auscultation in these mild cases reveals coarse mucous râles in the larger bronchial tubes, while the smaller tubes are free from mucus. Sibilant and sonorous râles are also observed, especially in the commencement of the bronchitis, at which time the secretion of mucus is suppressed or scanty. The cough in the commencement is for the same reason dry. It becomes looser by the second or third day, the sputum consisting of frothy mucus, with the admixture of pus and epithelial cells. The pus becomes more abundant as the disease continues. Expectoration from the mouth does not usually occur till after the age of four or five years; under this age the sputum is ordinarily swallowed.

The mild form of bronchitis described above, that in which only the larger tubes are affected, is common in infancy and childhood, but bronchitis of a non-severe type is also common, due to extension of the inflammation. It has already been stated that there is a tendency in bronchial inflammation to extend downward, and symptoms are proportionate in gravity to the degree of this extension. In severe bronchitis the pulse rises to 120 or 130 per minute, and the respiration is in a corresponding degree accelerated. The cough is frequent and painful, the pain being referred to the sternum, and often there is a steady dull pain in this region. The face is flushed and indicative of suffering, the temperature is considerably elevated, and the appetite is greatly impaired or lost. There is frequently an exacerbation of symptoms in the latter part of the day. Depression of the inframammary region during inspiration and dilation of the alæ nasi accompany grave attacks of the inflammation.

Auscultation in severe bronchitis reveals the presence of râles in all parts of the chest, sibilant and sonorous sparingly, coarse mucous and subcrepitant more abundantly.

General bronchitis or suffocative catarrh, the most dangerous form of this inflammation, is less frequent than bronchitis which is limited to the larger tubes or to the larger tubes and those of medium size. It may commence quite abruptly, but ordinarily it results from the milder form of the disease. The symptoms at first are such as occur in the common form of bronchial inflammation, but, instead of abating or remaining stationary, they gradually increase in severity till suddenly marked dyspnœa supervenes. The inflammation has now reached the minute tubes, and what promised to be an ordinary attack of bronchitis becomes one of great severity and danger.

The respiration in severe bronchitis is short and hurried. Sixty to eighty inspirations per minute are not infrequent, while the pulse also is greatly accelerated, attaining as high a number as 140 to 160 or 180 beats per minute. The cough is frequent, and the sputum, which collects in abundance, is expectorated with difficulty. If expectorated so as to be examined, it is found to consist largely of frothy mucus with epithelial cells. After a few days, if the patient live, it becomes more purulent. Sometimes, as in bronchitis of the adult, streaks of blood appear upon the mucus. In the first days of severe acute bronchitis the temperature is considerably elevated, the face flushed, and the breathing oppressed. The patient is restless, moving from one part of the bed to another, seeking in vain for relief. The digestive function is impaired, as in all severe inflammations; the tongue is moist and covered with a light fur; the appetite is nearly or quite lost. The infant takes the breast with difficulty, frequently relinquishing it on account of the dyspnœa; older children take no solid food in consequence of the anorexia and the dyspnœa, and even drinks are swallowed hastily and apparently without relish, since deglutition interferes with respiration. On auscultation in bronchitis of the minute tubes sibilant, and after a day or two subcrepitant, râles are observed in every part of the chest. Percussion elicits a good resonance unless the substance of the lung have become involved. As the disease approaches a fatal termination the pulse becomes greatly accelerated; the respiration is also in a corresponding degree frequent and panting, the inspiration being accompanied by increased inframammary depression and dilation of the alæ nasi. The face becomes pallid, the prolabia livid, and the tips of the fingers livid and cool. The mucus and pus, accumulating in the air-passages, increase more and more the obstruction to the entrance of air, and finally death occurs from apnœa. The nursing infant usually ceases to nurse several hours before death, and a state of stupor commonly precedes the fatal event, due to the accumulation of carbonic acid in the blood. In young infants, especially those under the age of six months, not only in bronchitis of the minute tubes, but in severe ordinary bronchitis, I have often observed toward the close of life intermission in the respiration. It occurs after every six or eight or ten respirations, and equals in duration the time occupied in perhaps half a dozen respiratory movements. It is therefore an unfavorable prognostic sign, but some in whom it occurs recover by active stimulation.

The duration of acute bronchitis varies according to the extent of the inflammation. In the mildest form the patient is convalescent after three or four days, and in severe cases that terminate favorably the disease begins ordinarily to decline by the close of the first week or in the second. The progress of bronchitis is somewhat more rapid in young children than in those of a more advanced age. When convalescence is fully established it is not unusual for the cough to continue three or four weeks, though gradually declining. It is loose and painless, and is scarcely regarded by the patient.

Death sometimes occurs as early as the second or third day in severe general bronchitis. The younger the infant, with the same extent and intensity of inflammation, of course the sooner the fatal result. The ordinary duration of fatal bronchitis is from six to eight days. If the patient pass beyond the tenth day, decline of the inflammation may be confidently expected, with recovery, unless there be a complication.

Occasionally bronchitis becomes chronic, lasting several months before it entirely ceases. The *chronic* form may result from mild as well as severe bronchitis. The acute fever and accelerated respiration which characterize the acute affection abate, and the general health is nearly or quite restored; but an occasional cough continues, and the respiration is often audible, from the mucus which collects in the tubes or from thickening of the mucous membrane. Sometimes there is moderate fever, especially in the latter part of the day. On auscultation coarse mucous, with perhaps sibilant and sonorous, râles are observed in the chest.

There is great liability in chronic bronchitis to exacerbations. The disease often seems to be abating and there is prospect of its speedy cure, when all the symptoms are intensified. The exacerbations are due to the fact that the bronchial surface, when it has been a considerable time inflamed, is very sensitive to the impression of cold. Even when the disease is entirely relieved it is very liable to return by exposure to currents of air or changes of temperature. Chronic bronchitis occurs most frequently in the winter, spring, and autumn, when the weather is changeable, and is most intractable in these periods of the year. Many cases of chronic bronchitis are associated with dilation of the bronchial tubes or with emphysema. The general health in this form of bronchitis, when not dependent on a tubercular deposit, ordinarily remains good. Tubercular bronchitis, which is the result of a grave disease, is treated of in our remarks on Tuberculosis. It is attended with emaciation, and is obstinate on account of the nature of the primary affection. It is due to the irritating effect of tubercular matter lying against the bronchial tubes.

DIAGNOSIS.—Bronchitis can ordinarily be diagnosticated by the character of the respiration and cough. The absence of hoarseness, stridulous inspiration, and croupy cough excludes laryngitis, and the absence of the expiratory moan and of the stitch-like pain on coughing, which characterize pneumonia and pleurisy, excludes these diseases. Accurate diagnosis, however, can be most readily made by percussion and auscultation. Examination of the chest enables us to state with positiveness not only the nature, but the extent, of the affection. If the inflammation be confined to the larger bronchial tubes, coarse râles are discovered in them, while finer mucous râles are absent. If the bronchitis be in the minute tubes, subcrepitant râles are discovered in them. Percussion gives clear resonance on both sides, except in those instances in which atelectasis or pneumonia has supervened.

PROGNOSIS.—Bronchitis limited to the larger bronchial tubes or to these and those of medium size terminates favorably in a large majority of cases. Occasionally, severe inflammation, not extending to the smaller tubes, proves fatal in young infants or those of feeble constitution. Bronchitis extending to the minute tubes is, on the other hand, a disease of great danger. It may be fatal at any period of childhood, but the younger and more feeble the patient the greater the liability to a fatal result. Under the age of one year it is one of the most fatal diseases of early life.

The prognosis in the commencement of all cases of bronchitis of average severity in the young child should be guarded, on account of the tendency of the inflammation to extend, as has been already stated in the preceding pages. After five or six days extension ceases, and if during that time no increase in the severity of symptoms occurs, the prognosis is favorable. Signs which indicate an unfavorable result are increasing frequency of pulse and respiration, difficult and scanty expectoration, restlessness, a countenance expressive of suffering, and a progressively greater accumulation of mucus in the bronchial tubes, as determined by auscultation. Pallor and coldness of the face and extremities, lividity of the tips of the fingers, rapid and feeble pulse, drowsiness, diminution of cough, while the mucus and pus accumulate in the bronchial tubes, and, in young children, intermissions in the respiration, indicate the near approach of death. Cases may, however, recover by proper treatment, although the symptoms are most unfavorable.

It is unnecessary to mention the favorable prognostic signs of bronchitis. This disease, when fully established, continues a certain number of days whatever remedial measures are employed, and if the symptoms do not increase in severity during the first five or six days a favorable result is highly probable. The prognosis in chronic bronchitis is ordinarily favorable, so far as life is concerned, provided that no emaciation occur. If there be emaciation the bronchitis may be due to tubercles in the bronchial glands or lungs, and of course the prognosis is less favorable.

TREATMENT.—Bronchitis may be rendered much milder, and perhaps prevented, by an emetic employed in the first twelve or twenty-four hours in conjunction with a warm bath. The physician is not, however, ordinarily called sufficiently early to render this treatment effectual.

Mild Bronchitis.—In mild bronchitis, the inflammation being limited to the larger tubes or to these and those of medium size, simple, soothing, expectorant, and laxative remedies are required. Mild counter-irritation may be produced by camphorated oil or a weak sinapism, and one of the following mixtures may be given. The late Dr. James Jackson of Boston, in his letters to a young physician, writes of the treatment: "For young children I employ the following: Take of either almond or olive oil, of syrup of squills, of any agreeable syrup, and of mucilage of gum acacia equal parts, and mix them. Of this mixture a teaspoonful may be given to a child two years of age; a little less if younger and increased if older, so as to double the dose to one in the sixth year. This may be given from three to six times in the twenty-four hours. Sometimes a little opiate must be added at night to appease the urgent cough." Another good medicine is the mistura glycyrrhizæ composita, half a teaspoonful of which should be given every two hours to a child of three years and one teaspoonful to one of six years. The syrupus ipecacuanhæ compositus of the French Pharmacopœia, the *contre de la toux*, consisting of ipecacuanha, senna, thyme, poppy, sulphate of magnesia, orange-flower water, wine, water, and sugar, being soothing and slightly laxative, is also a useful remedy. These cases also do well with simple mucilaginous drinks and confinement in a warm room.

Bronchitis affecting the Medium Size or Smallest Tubes.—The use of leeches has been, for the most part, abandoned in the treatment of bronchitis, not only in infancy, but at all ages. The application of dry cups over the sternum is recommended by some judicious physicians as a proper remedy for bronchitis in infancy as well as childhood, and the use of the wet cup is even advocated for robust infants in the commencement of the inflammation; but the beneficial effects derived from this treatment can be obtained by other measures which preserve the strength, and are therefore preferable.

Local treatment applied to the chest in bronchitis is important, since, if properly made, it increases the comfort and obviously diminishes the intensity of the inflammation. Henoch, whose ample experience and sound judgment command attention, if not acceptance of his views, says of local treatment: "I strongly advise hydropathic applications to the chest from the neck to the umbilicus. A napkin or diaper is dipped in water at the temperature of the room, well wrung out, and then placed around the chest, without exercising any compression, so that the arms are free; this is surrounded by a roll of batting and then covered by a layer of oil-silk or gutta-percha paper. When the fever is high these applications should be renewed at least every half hour; later they may be kept for one or even two hours, and this continued for several days and nights. I have occasionally continued it for a week, the cool water being changed to a temperature of 26° to 27° R."

The benefit derived from the cold-water application is, according to Henoch, threefold: First, the deep inspiration which the application of cold causes, thus expanding portions of the lungs which are liable to atelectasis; secondly, "derivative irritation of the skin;" and, thirdly, the production of moisture in the air surrounding the child, which he inhales. Deep inspirations are, in my opinion, caused to a greater extent by medicines which excite cough, as ammonia and warm applications certainly produce more derivation to the surface than cold. One benefit from the application of cold Henoch does not allude to, and that is the reduction of temperature. But I prefer for this purpose frequent sponging of the upper extremities and face with cold water, and perhaps its constant application to the head. I have observed marked relief from this use of cold water.

For years, in my practice, the following external treatment has been employed with apparent benefit in nearly every case. For infants under the age of three months who have accelerated respiration and painful cough, indicating the need of external treatment, two poultices of ground flaxseed are prepared, covered by thin muslin, and made so moist that they wet the hand in holding them. They are made as thin as the pasteboard cover of a book, and of such a size that, applied in front and behind, they cover the entire chest. Camphorated oil is smeared over their under surface three or four times daily, and over their exterior oil-silk is applied. For infants over the age of six months I prefer poultices of the following:

℞. Pulv. sinapis, ℥j;
Pulv. seminis lini, ʒxvj.

The poultice, to give most relief, should be so wet as to cause constant moist-
ıre of the surface, and so irritating as to cause constant redness without
tating its removal. Vesication should never be produced. Flannel
ıt of warm water made slightly irritating by mustard and covered
k also answers the purpose. External treatment should be employed
instances so long as the respiration is hurried and cough painful.
ıe stage of convalescence, instead of the poultice, cotton wadding or
round the chest increases the comfort and prevents taking cold.
the surface, early made and continued, tends to check the

downward extension of bronchitis. Often improvement in the symptoms is observed, especially less dyspnœa and restlessness, immediately on the employment of the local measures recommended above.

Internal Treatment.—Medicines are indicated which have a tendency to diminish the inflammation, to prevent its downward extension to the minute bronchial tubes, and to promote expectoration. The bowels should be kept open in all cases of bronchitis. For robust children at or over the age of six months the following prescription is useful in the commencement of the attack:

℞. Syr. ipecac.,
Spts. æther. nitr., *āā.* ʒij;
Ol. ricini, ℥iij;
Syr. bal. tolut., ℥j. Misce.

Dose: Half a teaspoonful to one teaspoonful, every second hour, for the age of one to two years.

But the medicinal agent which experience has shown to be the most useful in the bronchitis of children is one of the salts of ammonium. In the treatment of infantile bronchitis depression must be avoided. The cough should be strong and frequent, for the chief danger occurs from the accumulation of viscid mucus in the minute tubes, so as to obstruct the entrance of air into the alveoli, leading to atelectasis and causing the dyspnœa which is so painful and prominent a symptom in this disease. Ammonii carbonas or chloridum better than any other agent promotes expectoration by exciting cough and rendering the mucus less viscid, and it does not reduce the strength. When anxious parents ask me to prescribe something to relieve the cough, I reply that the more frequent the cough the better it is for the infant, since it affords the means of freeing the tubes from the accumulating mucus. Formerly I prescribed largely the carbonate, but Dr. Northrup, curator of the New York Foundling Asylum, has found evidences of gastritis in the stomachs of infants who have perished from various diseases for which the carbonate was administered. It should therefore be prescribed in a sufficient amount of mucilage or syrup or milk to prevent its irritating action on the stomach. I prefer to prescribe it in water, and direct it to be administered in milk. In feeble cases and cases attended by dyspnœa the carbonate is preferable to the chloride, since it is more stimulating, and it promotes the cough by slightly irritating the fauces. The ammonii chloridum may, in most instances, be given with benefit from the commencement, both in mild and severe bronchitis, in infants under the age of one year, but in severe cases it is apparently less efficient than the carbonate. The following is a convenient formula for its employment:

℞. Ammonii chloridi, ʒj;
Syr. bal. tolut., ℥ij. Misce.

Fifteen drops contain one grain, the dose at the age of three months. Five drops should be given at the age of one month, and thirty at the age of six months, in a little water. This expectorant should be given frequently, as every half hour or every hour in cases of severity. The urgent symptoms are relieved by free expectoration, which this medicine tends to produce. It should be given night and day, at the short intervals mentioned, until amelioration of symptoms occurs. The benefit from its use is most apparent under the age of eighteen months, or at the age when capillary bronchitis and atelectasis are most liable to occur.

Medicines which exert a greater controlling effect on the action of the heart than those which we have mentioned are often required during the progress of severe "bronchitis." If the patient give evidence of declining strength while the pulse is unusually rapid and the temperature elevated, quinine given in moderate doses, as two grains every fourth hour to a child of two years, has seemed to me useful as a heart tonic. It may be employed in the following formula:

℞. Quiniæ sulphatis, ʒss;
Syr. yerbæ santæ comp., ℥ij. Misce.

Give one teaspoonful every fourth hour.

The tincture of digitalis in doses of one or two drops every second hour for infants between the ages of six months and two years is also useful as a heart tonic. In a case recently under treatment by Dr. Jacobi and myself the infant, aged twenty-three months, having a temperature varying from 102½° to 105½°, respiration 82 to 105, and pulse 165 and higher, took four drops of tincture of digitalis, besides the quinine and ammonii chloridum, three days, with apparently a good result from the digitalis. This remedy was afterward continued in two-drop doses, and the patient recovered.

For robust children, with a strong and rapid pulse, with a temperature above 102°, the use of an antipyretic is indicated. Formerly, aconite or the more dangerous remedy, veratrum viride, was employed for this purpose; but a better antipyretic for these cases is antipyrine, acetanilide, or phenacetin. One grain of antipyrine, which is soluble in water, may be administered every third hour to an infant of one year. If the temperature fall to 102°, it should in ordinary cases be discontinued, since it is in a measure depressing. Its use is seldom required longer than two or three days. For feeble children, or those who have atelectasis or pneumonia complicating the bronchitis, quinine is preferable to either of the above antipyretics.

When and how to employ opiates to procure the needed rest in the bronchitis of children should be carefully considered. We have stated that a frequent and strong cough is required in the infant in order to prevent clogging of the minute tubes with muco-pus and to prevent atelectasis. Still, some respite from the cough, if it be frequent, is required to prevent exhaustion. I prefer for young infants to give the opiate separately from the expectorant, and only occasionally as they may need sleep. The following is a useful formula for an infant of six months if it be restless and without the proper amount of sleep:

℞. Liq. opii composit. (Squibb), gtt. x;
Potass. bromidi, ʒj;
Syr. rubi idæi (raspberry), ℥j;
Aquæ, ℥iss. Misce.

Dose: One teaspoonful when needed.

Eight drops of paregoric may be given in place of the above. Twice the dose of either of these opiates is sufficient at the age of twelve months. For older children Dover's powder—an eligible form of which is Squibb's liquid Dover's powder, the tinctura ipecacuanhæ composita, one minim of which corresponds to one grain of the powder—is a useful remedy to procure sleep.

During convalescence medicines should be administered less and less frequently or in smaller doses. Emetics in ordinary cases of bronchitis are not required, except in the commencement. In severe bronchitis, however, especially when the smaller tubes are inflamed, they sometimes appear to be useful. The cases which may need their administration are those in which mucus and pus collect in the tubes more rapidly than they are expectorated, so as to give rise to urgent dyspnœa. An emetic administered under such circumstances may give prompt and decided relief. The object to be gained is obviously very different from that in the commencement of bronchitis, and such agents should be employed as act promptly with little depression. Ipecacuanha is probably the best emetic for this purpose.

Infants oppressed by the accumulation of mucus and pus may sometimes be relieved by tickling the fauces with the finger. This provokes vomiting, and the viscid mucus which collects at the entrance of the glottis is removed by the finger.

The diet should, as a rule, be nutritious through the entire disease; but robust patients or those who have ordinary health, if over the age of two years and affected with primary bronchitis, are sufficiently nourished by light diet, chiefly farinaceous, in the first days of the attack, after which animal broths are proper. Whatever food is given in severe bronchitis must be in the form of drinks, since the appetite is lost and solid food is not taken, while the thirst is such that liquids are less likely to be refused.

In primary bronchitis, if mild or of ordinary severity, alcoholic stimulants are not required. In secondary bronchitis they are often needed, and also in severe primary bronchitis if there be dyspnœa with evidences of prostration. In the infant two drops of brandy for each month in the age, given every hour or second hour, enable the child to expectorate with more freedom and less exhaustion.

CHAPTER VI.

ATELECTASIS.

In certain new-born infants the lungs do not undergo inflation or only a portion of the lobules is inflated—to wit, those in the upper lobes—while the remainder of the organ continues unchanged from the fœtal state. This non-inflation of the lung is designated congenital atelectasis. It is apparently not due, unless in rare instances, to defective formation of the respiratory apparatus, for at the autopsies of cases which have ended fatally, as most cases do at an early period, insufflation is easy, there being no occlusion of the air-passages nor unusual adhesion of the walls of the alveoli to prevent the admission of air. Physicians have believed that in some instances they discovered the cause in an enlarged thymus gland, which compressed the lower part of the trachea, but this cause has not seemed to exist or was exceptional in cases which I have observed; for although the thymus at birth is large, having nearly the size of an unexpanded lung, it has not seemed to me to be unduly enlarged in most atelectatic cases which I have examined after death.

The ordinary proximate cause of atelectasis neonatorum is feebleness of inspiration, whether due to general debility, as in infants born prematurely, or weakened by placental hemorrhage in the last months of fœtal life, or, as is frequently the case, to injury of the brain and consequent impairment of the function of the pneumogastrics during birth. I have more fully treated of this form of atelectasis in the chapters which relate to the maladies incidental to the birth of the child, and to these the reader is referred.

Acquired atelectasis, or collapse of lung, is less extensive than congenital atelectasis, being confined to a portion of a lobe and often to only a few lobules. It occurs chiefly during the period of infancy and in feeble children. It is a common malady in foundling asylums in wasted infants who perish before the close of the first year. I have frequently at the autopsies of such infants observed it along the thin inferior margins of the lower lobes and in the tongue-like prolongation of the left upper lobe. In this class of cases catarrh of the bronchial tubes appears to have little or no agency in causing the collapse. The cause is found in the impaired functional activity of the lungs. In the state of debility the heart beats feebly and the stream of blood from it to the lungs is small and slow, so that the inspiration of a small amount of air suffices for its decarbonization. The inspirations also are seen to be feeble, causing little expansion of the walls of the thorax. Consequently, the entire lung is imperfectly inflated, as is seen in fatal cases, but the distant thin portions of the organ are least expanded. These, receiving little or no air, soon begin to contract from the presence of the elastic tissue, and collapse or atelectasis ensues.

This has been the most common form of atelectasis in cases of this malady which I have observed in foundling asylums, and it probably occurred in the manner which I have described.

Another cause of acquired atelectasis to which all writers allude is bronchial catarrh, which, commencing in the larger tubes, extends downward into those of smallest size. By the swelling of the mucous membrane and the accumulation of viscid muco-pus, which cannot be expectorated, certain of these tubules become occluded, so that the inspired air is shut off from the alveoli situated beyond them. Occlusions are obviously most likely to occur in the bronchitis of feeble infants whose cough has little expulsive force, so that debility is also a factor in the production of this form of atelectasis. The portion of lung withdrawn from the respiratory function soon collapses, the air which it contained being probably in part expired, but chiefly absorbed.

Atelectasis is not, however, so important or frequent a complication of bronchitis as was formerly supposed, for catarrhal pneumonitis due to extension of the inflammation from the bronchioles into the lung has been mistaken for it. Solid non-crepitant nodules or portions of lung are frequently observed at the autopsies of infants who have perished of severe bronchitis, and these may be atelectatic or pneumonic, but they are more frequently the latter than was formerly supposed.

The possibility of insufflating these solid portions when removed from the body after death was till within a few years regarded as decisive proof of atelectasis. It is now known that this is not a reliable test, since a lung solidified by recent catarrhal pneumonitis can be almost as readily inflated as one which is collapsed; but the inflated pneumonic lung is more solid and resisting when pressed between the thumb and fingers than is the collapsed lung. The decisive proof is afforded by the microscope, by which cell-proliferation is discovered within the alveoli in catarrhal pneumonitis, while it is lacking in simple collapse. An increase of the dyspnœa not infrequently occurs in severe infantile bronchitis, without either pneumonia or collapse from the accumulation in the bronchioles of the secretion which is with difficulty expectorated, but if dulness on percussion and other physical signs indicate solidification of the lung at some point, of course pneumonia or collapse has occurred. If a sufficient amount of lung be involved to produce well-marked physical signs, the disease is in most instances pneumonia and not collapse, though it may be the latter. Both these pathological states may, however, occur in the same lung as complications of severe bronchitis. The severe paroxysmal cough of pertussis, especially when accompanied by considerable secretion, frequently produces collapse of portions of the lower lobes, while it causes emphysema in the upper lobes.

SYMPTOMS.—Atelectasis resulting from bronchitis gives rise to no new symptoms. So far as it has any appreciable effect, it aggravates certain symptoms of the primary disease, but as it is ordinarily limited to a small area, this effect is not very marked. When a bronchial tube is so occluded by muco-pus that the alveoli with which it communicates collapse, there is ordinarily at the same time more or less accumulation of this secretion in other tubes throughout the lungs. Therefore, the entrance of air into the alveoli with which these tubes communicate is slow and difficult, but usually without complete obstruction and without true atelectasis, but with a semi-collapse such as we observe in fatal croup. This explains the dyspnœa which is present in these cases. If the secretion be expectorated from these tubes, the dyspnœa abates, even if the plug which has completely occluded a tube and the consequent atelectasis remain.

Atelectasis occurring in wasted and feeble infants in consequence of the diminished force of the inspirations does not in most instances give rise to any prominent symptom, since it occurs chiefly in distant thin portions of the lungs. I have observed an occasional short, nearly painless, cough in such infants when the autopsy revealed no pulmonary lesion except the atelectasis.

ANATOMICAL CHARACTERS.—The portion of lung which is affected with recent atelectasis has a dark-brown or dark-bluish color. It is depressed below the general level of the lung, is firm and non-crepitant on pressure, and its incised surface is smooth. Hyperæmia supervenes, for a portion of lung in which the circulation continues, but from which air is excluded, becomes congested. In acquired atelectasis the congestion is especially marked, since the vessels which have been adapted by growth for a larger area are compressed into one of smaller extent, so that they become tortuous and bulging within the lumina of the alveoli, while the free flow of blood through them is retarded by the constriction of the elastic fibres of the lung. An obvious and certain result of the hyperæmia is the transudation of serum into the alveoli, producing œdema. This union of pulmonary hyperæmia with œdema, by which air is excluded from the alveoli, constitutes the state known to pathologists as splenization, and in proportion as it occurs the lung depressed by the atelectasis rises toward the general level. It may even rise above it, and it now has a doughy, elastic feel. The pathology of these œdematous atelectatic spots, heretofore obscure, has been clearly explained by Rindfleisch.

If the patient live and the atelectatic lobules do not soon return to a state of health, they undergo further changes. Rindfleisch says: "From the series" (of changes, provided inflammation do not occur) "we especially render prominent two conditions—*inveterate œdema* and *slaty induration*. But inflammation does commonly occur after a time in a collapsed lung." Those who are familiar with the post-mortem examination of infants will fully agree with Rindfleisch when he says: "Splenization, quite generally taken, appears to present extraordinarily favorable preliminary conditions for the occurrence of inflammatory changes. It may directly represent the initial hyperæmia of acute inflammation, and be followed by lobular and lobar, but constantly catarrhal, infiltrates." It is well known by pathologists that protracted congestion, active or passive, of whatever organ or tissue, is very liable to pass from a state of simple stasis of blood to one of cell-proliferation, and the atelectatic lung, as I have myself observed at autopsies, affords a common example of this. I have several times made or have procured microscopic examinations of the atelectatic portions of lungs of infants who had died for the most part in a wasted and enfeebled state, and have found in them clear evidence of the presence of a catarrhal pneumonia.

The interesting fact therefore must be recognized that atelectasis frequently passes to a state of inflammation, so as to present the characters of ordinary hypostatic pneumonia, and no doubt undergo the same subsequent changes.

Atelectasis when recent and simple or uncomplicated may soon disappear by the expectoration of the obstructing secretion, if such be present, or if there be no obstruction by increased force of inspiration. If it do not soon disappear it undergoes one of the ulterior changes alluded to above, and henceforth the symptoms and history are those of the new malady which has supervened.

TREATMENT.—The treatment of acquired atelectasis is simple. If it be recent and there be evidence that it is due to the accumulation of the secretion in the bronchial tubes, an emetic which acts promptly and with the least possible depression may be very useful. It is especially indicated if there be little or no pneumonia, the strength not greatly reduced, and there be dyspnœa with insufficient decarbonization of blood in consequence of the abundance of the secretion in the smaller tubes. An emetic which acts promptly and with little prostration may aid greatly in establishing the respiratory function in collapsed lobules by expelling the obstruction and producing a freer and deeper inspiration. One of the best if not the best emetic for this purpose is sulphate of copper, given in a dose of one or two grains to a child of one year. With or without the use of the emetic, our main reliance must be on sustaining and stimulating measures, by which the cough, the cry, and the inspirations acquire more volume and force. Most cases require alcoholic stimulants and the ammonium carbonate. Rubefacient applications to the chest are also commonly employed, and are probably useful.

CHAPTER VII.

PNEUMONIA.

CATARRHAL PNEUMONIA.

THIS is the common form of pneumonia under the age of three years. In most cases it results from bronchitis by extension of the inflammation. Hence it is designated by the terms broncho-pneumonia and lobular pneumonia.

ETIOLOGY.—Catarrhal pneumonia, as we have stated above, commonly results from simple bronchitis. The inflammation, affecting first the larger bronchial tubes, extends to the bronchioles, and from them to the air-cells in certain lobules. Its causes under such circumstances are evidently the same as those of the bronchitis which precedes and accompanies it. It often occurs as a complication of certain infectious maladies, among which we may mention pertussis, measles, diphtheritic croup, influenza, and, more rarely, scarlatina, variola, typhoid fever, and erysipelas. Ill-nourished, rachitic, and anæmic children with little power of resistance are most liable to it. It is in the cities especially common among the children of the tenement-houses, who live in small, overcrowded, overheated, and dirty apartments, and are frequently taken from these apartments to the lower temperature of the streets or are exposed at open windows. Different opinions have been expressed as to the mode in which pneumonia supervenes upon capillary bronchitis. The theory of direct propagation of inflammation from the minute bronchial tubes to the air-cells is plausible, but Buhl holds that the alveoli become inflamed by the entrance into them from the bronchioles, during inspiration, of inflammatory products, which act as an irritant. A form of subacute catarrhal pneumonia sometimes results from hypostasis or passive congestion. It is not uncommon in infant asylums in infants enfeebled by chronic disease, who have weak action of the heart and languid circulation. Lying in their cribs day after day, with little movement of the body, they are very liable to passive congestion of depending portions of their lungs, and this by and by eventuates in a pneumonia presenting some peculiarities, but of the catarrhal form. It is sometimes designated hypostatic pneumonia. It is so frequent in foundling asylums, where feeble infants are received and treated, that certain physicians, whose observations have been largely in such institutions, have almost ignored any other form of pneumonia in infants. Billard, a close and accurate observer, wrote nearly half a century ago: "Pneumonia of infancy presents peculiar characters, in which it differs from the same affection in adults. Instead of being an idiopathic affection arising from irritation developed in the pulmonary tissue under the influence of atmospheric causes, which often excite the disease, the pneumonia of young infants is evidently the result of a stagnation of blood in their lungs. Under these circumstances this blood may be regarded as a kind of foreign body. . . . . It would therefore appear that inflammation of the lungs, which produces hepatization, arises in infants, in general, from some mechanical or physical cause." Valleix also states that he found the lesions of pneumonia in a majority of the infants who died in the Hôpital des Enfants Trouvés. The statements of Valleix are applicable also to the Infants' Hospital, the Foundling Asylum, and the Nursery and Child's Hospital of this city, as regards those cases in which death results from chronic disease. We shall see hereafter that hypostatic pneumonia is also a common complication of chronic infantile entero-colitis, the summer complaint of the cities.

Catarrhal pneumonia of infants sometimes results from atelectasis or collapse. It is not unusual to find, at the autopsies of infants who have died in a state of emaciation and feebleness, portions of the lungs remote from the bronchi collapsed, as, for example, the thin edges of the inferior lobes and the tongue-like process of the upper lobe, the process which lies over the heart. The immediate cause of the collapse has been a bronchitis, or it has resulted directly from the general weakness of the infant and its feeble respirations. Now, a collapsed lung soon becomes the seat of passive congestion. The functional activity of an organ favors circulation through it, and if the function be abolished the flow of blood in the part is retarded and stasis more or less complete results. The hyperæmic state of collapsed pulmonary lobules presents the same anatomical condition for the supervention of pneumonia as occurs in cases of hypostatic congestion. Consequently, cell-proliferation soon begins in the collapsed alveoli, the volume of the affected lung increases and it becomes firmer and more resisting to the touch, and the microscope reveals the characters of a subacute but genuine catarrhal pneumonitis. I have made or have procured microscopic examinations of a considerable number of such specimens, and have found the alveoli more or less filled with cells of the epithelial character. (See article Atelectasis). Pneumonia resulting from hypostatic congestion and that occurring from atelectasis are not only subacute, but usually protracted.

Anatomical Characters.—If we have an opportunity to make a post-mortem inspection of the inflamed lung when broncho-pneumonia has continued a few days we will find the pleura covering it either normal or covered in spots with a thin film of fibrin. The bronchial tubes contain muco-pus, and their walls are thickened and congested. The inflamed lobules are few or many, and they are more numerous in the lower lobes and in its posterior portion than elsewhere. Their incised surface is not granular, as in croupous pneumonia, but smooth, and its color in recent cases is a pale red or deep red. In protracted cases the color may be grayish, but the change from red to gray hepatization does not occur as early as in lobar or croupous pneumonia, so that weeks after the commencement of inflammation in the lobule its color may be red. White points or lines in the lobule indicate the location of the bronchioles. The inflamed lobule is in some cases very distinct from the surrounding healthy parenchyma, but in other instances it gradually blends with it.

In some cases the air-vesicles contain chiefly pus, in others chiefly epithelial cells or epithelial cells and pus, and in others still epithelium, pus, and fibrin. Mixed with these inflammatory products we detect also red blood-corpuscles. The capillaries in the walls of the vesicles are large and sinuous. The amount of inflammatory products in the alveoli varies greatly in different cases. The alveoli may be only partially filled, or they may be so packed that it is difficult to detect the alveolar walls. The adjacent non-hepatized lobules do not exhibit any marked change, except that their epithelial cells may be somewhat swollen and more distinct than in health. The bronchial tubes not only contain more or less muco-pus and epithelial cells, but their walls are frequently thickened and infiltrated with pus-cells and connective-tissue cells. This infiltration causes the bronchioles to appear as white lines or dots in the inflamed area.

In protracted cases the red color changes to gray, this change commencing in the interior of the lobules and extending outward. In gray hepatization the epithelial and pus-cells have undergone granulo-fatty degeneration. If resolution do not occur and the disease reach a still more advanced stage, the granulo-fatty degeneration becomes more complete, and the lobules enter the stage of cheesy degeneration, becoming yellowish-white and hard and homogeneous, the elements which make up the lobules being no longer discernible. The ulterior change in the gravest cases is softening and the formation of

FIG. 42.

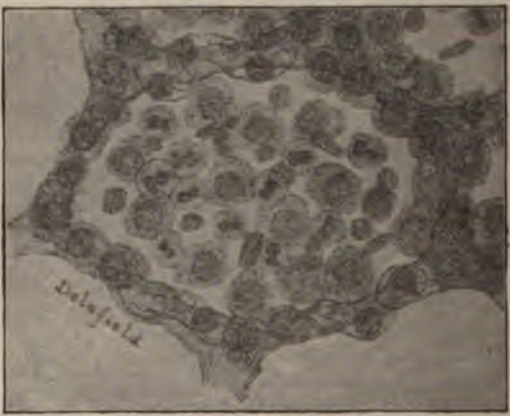


Fig. 42 represents an inflamed air-vesicle from the lung of a child who died of catarrhal pneumonia supervening on pertussis.

cavities, or interstitial pneumonia may supervene, with an increase of the connective tissue. Cheesy degeneration and interstitial pneumonia are much more frequent in lobular pneumonia, the disease which we are describing, than in lobar or croupous pneumonia, and when the stage of cheesy degeneration is reached the conditions are present in which tuberculosis is likely to supervene.

FIG. 43.

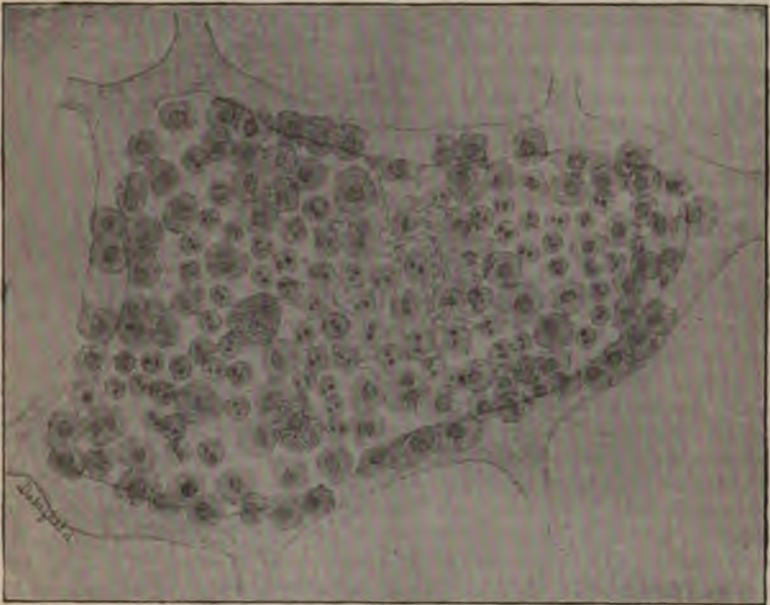


Fig. 43 represents lobular pneumonia of a more severe grade, some fibrin being present in the centre of the air-vesicle. Both plates are copied from Delafield's *Pathological Anatomy*.

In a large proportion of instances, when broncho-pneumonia has not continued longer than two or three weeks, the inflamed lobules can be inflated after death. We would infer that this would be possible in cases in which the alveoli are only partially filled with the cellular elements. It was formerly supposed that if an infant died, having had the dyspnœa and other symptoms characteristic of severe bronchitis or broncho-pneumonia, and portions of the lungs were found firm and without air, if they could be inflated the pathological state was atelectasis; if they could not be inflated, it was pneumonia. But I have many times been able to inflate lobules that were undoubtedly inflamed, though when inflated they were still semi-solid on palpation, so that the fact of insufflation or non-insufflation is not a test of the presence of atelectasis or pneumonia. Still, as we have elsewhere stated, a lung primarily collapsed is very liable to take on a low grade of pneumonia.

CROUPOUS PNEUMONIA,

also designated fibrinous pneumonia and lobar pneumonia, is the common form of pneumonia in the adult, and it is not infrequent in children over the age of five years. It rarely occurs under the age of three years, but cases have been reported. It involves an entire lobe or a large part of a lobe. Besides the parenchyma, the smaller bronchial tubes also participate in the inflammation. Croupous pneumonia is usually a primary disease, but it is occasionally secondary, as, for example, when it occurs in certain debilitating diseases, as nephritis, or in infectious diseases, as occasionally in measles and pertussis.

Etiology.—Formerly croupous pneumonia was commonly attributed to catching cold, but the microscopic examinations and experiments of Klebs, Friedländer, and Fränkel have shown that this disease is microbic, and the two latter gentlemen, it is believed, have detected the microbe which causes the inflammation in ordinary cases, and they have given it the name pneumococcus. It has a breadth of about one-third its length, and it occurs in groups of two or more surrounded by a gelatinous envelope. According to the observations of Salvioli, Eberth, and Nauwerk, it appears that the pneumococci may also enter the general circulation, and, being conveyed to distant organs, may excite inflammation in them; as, for example, nephritis, meningitis, and pericarditis. In ordinary cases of croupous pneumonia it is probable that the pneumococcus has entered the lungs by inspiration of infected air, and certain observers believe that it sometimes enters the blood and produces disease elsewhere, while the lungs escape. Croupous pneumonia is more common in certain years and certain seasons than in others. Its frequency in the spring months has been mentioned by physicians in different countries. It was common among children, according to my observations, in April, 1890, in New York City, after a mild and very rainy winter, the disease commencing suddenly with considerable elevation of temperature, and the physical signs of pneumonia being sufficient for diagnosis on the second, third, or fourth day. Epidemics of croupous pneumonia sometimes occur in certain localities, lasting weeks or months, and there are also certain infected houses in which new cases of this inflammation occur during many months. In the Amberg prison in 1880, 161 cases of pneumonia were treated, and in the ceiling of the dormitory in which most of the cases occurred Keller detected pneumococci, cultivated them, and successfully inoculated animals with them. Bad ventilation, overcrowding, and uncleanliness favor the occurrence of pneumonia, and epidemics have ceased when troops were removed from crowded and infected barracks to those that were more spacious and cleaner.

It is the opinion of some good observers that other microbes besides the pneumococcus may cause croupous pneumonia—that when this form of pneumonia occurs in the common infectious diseases, as scarlet fever, pertussis, and measles, the specific microbes of these diseases enter the alveoli and excite the inflammation. Prof. Prudden, who has given much attention to the pathology of pneumonia, expresses the opinion that while the pneumococcus ordinarily causes croupous pneumonia, it may result from other microbes, especially when it occurs as a complication of the common microbic or infectious diseases. It is a question also whether it does not sometimes occur without the agency of microbes—especially from taking cold, in accordance with the popular belief—and in those rare cases in which it results from severe injuries it seems probable that the microbe is not the causal agent.

Anatomical Characters.—Croupous or lobar pneumonia affects an entire lobe or even an entire lung. Its first stage is that of congestion, which is characterized by distension of the arterioles and an increased afflux of blood part. In the second stage, or that of red hepatization, the lung becomes lid and resisting on palpation, and at the same time it breaks down pressure. Its color is a deep red, and its section presents the ice of granules closely aggregated. Each granule is the contents of ll. The bronchial tubes connecting with the inflamed lobule contain muco-pus, fibrin, and epithelium, and the pleura covering the inflamed lobe is coated with fibrin.

The substance which fills the air-vesicles and gives the torn or incised surface of the inflamed lobe its granular appearance consists of epithelial cells, pus-cells, red blood-globules, and fibrin. The blood-vessels are distended with non-coagulated blood. The fibrin usually occurs in a network. The epithelial cells are abundant, and they are frequently enlarged and granular. The pus-cells are abundant; the red corpuscles are few, or they may be so abundant that they fill some of the air-vesicles. When the second stage, or that of red hepatization, is completed, the air-vesicles are entirely filled with the inflammatory products, so that in the cadaver they cannot be inflated. The third stage, or that of gray hepatization, gradually supervenes after a few days upon the stage of red hepatization, a gray mottling first occurring; subsequently the gray color becomes complete. In this stage the same elements remain, but the congestion diminishes, the red corpuscles lose their color, and the inflammatory products gradually undergo granular degeneration. When they are filled with granules the red color is entirely replaced by the gray. Dr. Delafield states that the inflamed lung was found in this state in one-fourth of the cases examined by him. Death occurred in these cases between the fourth and twenty-fifth days. The stage of resolution succeeds in favorable cases, in which the inflammatory products soften, liquefy, and are absorbed or expectorated. The hepatized lung, instead of resolving, may undergo a change identical with or closely resembling cheesy degeneration. It becomes dry and firm and of a white cheesy color. Epithelium, pus, and fibrin can be detected in some of the alveoli, while in others they are replaced by a granular mass. Again, in severe cases portions of the lung may undergo necrosis in consequence of arrest of circulation. Delafield

FIG. 44.

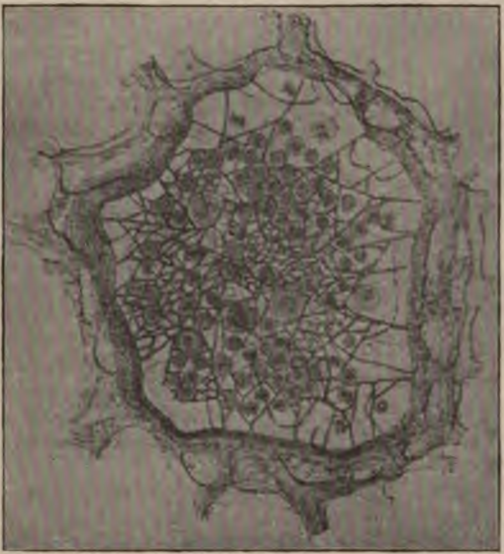


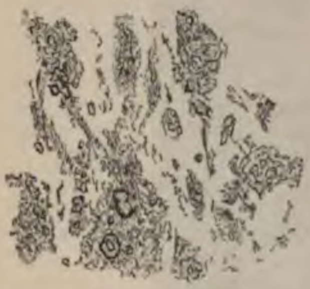
Fig. 44, copied from Delafield's *Pathological Anatomy*, represents an air-vesicle from the lung of a patient who died forty-eight hours after the commencement of croupous pneumonia. The vesicle is only partially filled with inflammatory products, on account of the brief duration of the inflammation.

has observed in these cases the presence of a large amount of fibrin, and but little pus and epithelium. At a later stage the cavities formed contained pus. This is a serious state, which is likely to eventuate in cheesy degeneration of the bronchial glands and tuberculosis.

SEPTIC OR EMBOLISMAL PNEUMONIA.

In rare instances in infancy and childhood pneumonia results, as it more frequently does in the adult, from an embolus detached from a clot which had formed in some remote vein, in consequence of arrest of circulation in it, by inflammation of the contiguous tissues. This is described by writers as a distinct form of pneumonia, designated embolic or embolismal. A specimen showing this mode of causation was exhibited by me at the New York Pathological Society in February, 1868. An infant, born January 22, 1868, of strumous parents had been fretful, but without appreciable ailment till February 3d, when inflammation of the connective tissue occurred on the anterior aspect of the left leg, a little below the knee. This extended downward, suppurated, and the pus was evacuated February 5th. In the mean time three other similar inflammations occurred—two on the right foot and leg, and the other over the parietes of the chest in the right inframammary region. Suppuration occurred in all of these.

FIG. 45.



On February 8th this infant was suddenly seized with extreme dyspnœa, and died in a few hours. Numerous minute puriform collections (formerly called metastatic abscesses) were discovered in each lung, most of them scarcely larger than a pin's head. One of them, on the right side in the middle lobe, connecting with a bronchial tube, had ruptured into the pleural cavity, causing pneumothorax, collapse, and incipient pleuritis.

The annexed figure exhibits the microscopic appearance of this softened fibrin, which to the naked eye so closely resembled pus.

On account of the speedy death the emboli had produced in the lobules where they had lodged little more than congestion or the first stage of pneumonia around them. Had the infant lived longer, doubtless the microbes and ptomaïnes would have caused a greater amount and more advanced stage of pneumonia.

CHEESY PNEUMONIA.

Cheesy degeneration of the inflammatory product occasionally occurs in the croupous form of inflammation, but it is more common in the catarrhal. I have most frequently observed it in New York during epidemics of measles, when this form of pneumonia supervened upon the catarrhal bronchitis of that disease. Cheesy pneumonia is in its nature chronic and attended with great reduction of the vital powers.

Cheesy degeneration of the exudate consists essentially in the absorption of the liquid portion and fatty degeneration of the solid. The obstruction of the circulation in the capillaries and the accumulation of cells in the alveoli and bronchioles which cannot be expectorated are conditions which favor cheesy metamorphosis. The appearance and consistence of the lung when it has undergone this change are well expressed by the term which is employed to designate it. The cheesy mass consists of fatty, shrivelled, and fragmentary cells, and amorphous matter in which can be traced the fibres of connective tissue and larger vessels of the parenchyma, the other histological elements having disappeared.

The caseous mass after a time softens, attracting moisture from the surrounding tissues. The molecular detritus and the shrivelled cells are now suspended in a liquid, and, like any dead matter, they are irritant to the surrounding lung-substance. The bronchial tube which supplies the affected lobule, and which in many instances was the starting-point of the disease, again becomes pervious, either by softening of the plug or by ulceration at a higher point upon its walls, and air is admitted, which promotes the putrefactive process and chemical changes of the caseous substance.

The presence of softening caseous matter in the lungs very frequently leads to the development of tubercles (see art. Tuberculosis), and accordingly before the case ends clusters of tubercles may appear in the connective tissue and walls of the vessels of the lungs and in other organs.

In the subsequent progress of cheesy pneumonia, if the patient live sufficiently long, more or less expectoration of the offending substance occurs, producing a cavity. Around the cavity a vascular pyogenic membrane forms, upon which granulations arise. These granulations, which produce pus abundantly, and from which small extravasations of blood are frequent, are gradually transformed into connective tissue. If the dead portion be expectorated and there be a single small cavity, the child may recover, the empty space being finally filled up by the extension of the granulations and the production of a cicatrix, which contracts, producing a puckered appearance. Ordinarily, however, there are several centres of caseous degeneration, and several cavities resulting, which continue to enlarge by the progressive softening of the cheesy matter. Often, also, the cavities intercommunicate. The bronchial glands undergo hyperplasia, and certain of them are liable also to become cheesy. As the disease advances the suppuration and expectoration increase. The fatal result occurs sooner in children than in adults, and therefore the destructive and inflammatory lesions observed at autopsies are ordinarily not so far advanced in the former as in the latter. Other unfavorable changes may occur in the hepatized lung, but cheesy degeneration is the most common and noteworthy.

To the possibility of inflating a lung which presents to the naked eye the appearance of pneumonia we have alluded in a foregoing page. The facts as regards the possibility of insufflation are these: In croupous pneumonia, when it has passed beyond the first stage, insufflation is impossible in the lung of the child as well as adult with the utmost force of the breath. We produce emphysema in healthy portions of the lungs, while the inflamed area is not encroached upon.

On the other hand, in catarrhal pneumonia, which we have seen is the common form of pulmonary inflammation in children under the age of three years, and in which less distension of the air-cells by inflammatory products occurs, the lung can be inflated, except in protracted cases, but when fully inflated the solidified lobules can still be felt between the thumb and fingers. In protracted catarrhal pneumonia, as well as in protracted collapse—which, indeed, may and often does become a pneumonia—full inflation is impossible. Central portions still remain impervious to air. While, therefore, the possibility or impossibility of inflating a lung removed from an adult, and which presents to the naked eye the appearance of pneumonic solidification, is a valuable sign as indicating whether or not the disease be pneumonia, this test is uncertain and unreliable when applied to the pulmonary lesions of children under the age of three years.

Symptoms.—Croupous pneumonia commonly begins abruptly or it is preceded for a brief period by symptoms of a cold. In the adult the abrupt commencement is ordinarily with a chill. In the child there is often a sensation of chilliness, but a distinct chill is not common. Convulsions sometimes occur in place of a chill. Catarrhal pneumonia, being ordinarily consecutive to bronchitis, begins in a more gradual way, its symptoms being preceded by and associated with those of the primary affection.

The symptoms of acute pneumonia, whether catarrhal or croupous, are the following: Anorexia, thirst, restlessness, elevation of temperature, acceleration of pulse according to the intensity of the inflammation and the feebleness of the patient, flushed face, a countenance expressive of suffering, accelerated respiration, with an expiratory moan. These symptoms are constant in the acute inflammation unless of the mildest form. Those which are important I shall explain more fully.

The expiratory moan is described by writers as a pathognomonic symptom of pneumonia or of pleurisy. It is due to the pain experienced from the movement of the inflamed part. As a rule, the expiratory moan indicates either pneumonia or simple pleuritis; but there are exceptions. It may occur, for example, from indigestible substances in the stomach and intestines, giving rise to acute dyspepsia, or from certain forms of abdominal inflammation which render movements of the diaphragm painful, as diaphragmatic peritonitis.

The cough in the first days of pneumonia is usually dry or hacking and painful. It afterward, if the case be favorable, becomes looser and is painless. We very seldom observe in the child the bloody sputum which characterizes pneumonia in the adult, since in catarrhal inflammation there is much less exudation of blood-corpuscles. The sputum, which in this form of the disease is the product of secretion and cell-proliferation, is at first thin and frothy, but afterward thicker and less tenacious from the increased number of cells. There is often, in the first period of the inflammation, pretty severe and constant headache, the patient complaining of the head, if old enough to speak, before he does of the chest. In a severe attack the child at this period lies with the eyes shut, apparently in a half-conscious state, fretful if spoken to or aroused, so that the physician may be led to suspect the presence of cerebral disease. If there be vomiting accompanied with sudden twitching of the muscles and convulsions—symptoms which sometimes occur—the liability to error in diagnosis is greatly increased. Cerebral symptoms are more prominent in the commencement of pneumonia than subsequently. As the disease advances they subside, and symptoms referable to the chest become more conspicuous.

The breathing is, as I have said, accelerated. Thirty or forty respirations per minute are common, and in severe cases the number reaches sixty or even eighty. In infants there is greater frequency of respiration than in children. In those at the breast, if the dyspnœa be urgent, nutrition is sometimes seriously interfered with, since in these severe cases respiration is performed more through the mouth than nostrils, so that if the infant seize the nipple it is forced to relinquish it in order to breathe, dilation of the alæ nasi and depression of the inframammary region accompanying inspiration. The dyspnœa in catarrhal pneumonia is often due in great part to accompanying bronchitis.

The temperature in mild cases of pneumonia is elevated to about 101° to 103°; in severe cases it may reach 105° or even 107°, the former being the highest observed by Mr. Squire. In 97 observations made by M. Roger the average temperature was 104° during the active period of the inflammation. The face is therefore flushed and the heat of surface pungent, except in weakly children, in whom, even in severe and active inflammation, the face is sometimes pallid and the extremities of natural or less than natural temperature.

The tongue is moist and covered with a light fur; the thirst is such that nutriment may be given in the form of drinks when the loss of appetite prevents the use of solid food. The bowels are usually constipated. The secretions in the first and second stages are diminished. The urine is more deeply colored than in health, and in vigorous patients it deposits urates on cooling. The chlorides are also deficient or absent from the urine so long as the inflammation is extending.

In favorable cases in from seven to ten days the heat and thirst decline; the pulse and respiration gradually become less frequent; the cough looser; the features have a more placid or contented expression; the appetite returns; and the patient is again amused by playthings. The improvement is progressive, but gradual. A slight cough is occasionally observed two or three weeks after convalescence is fully established.

Death in the acute stage of the inflammation commonly occurs from asthenia. The pulse gradually becomes more frequent and feeble, the respiration more oppressed, and finally, near the close of life, the face and extremities become cool. Occasionally death results from apnœa, due in great part to coexisting bronchitis. In exceptional instances it occurs from convulsions, followed by coma, especially in the first week. In those protracted cases in which the inflammatory products have undergone cheesy degeneration death occurs from asthenia.

Such are the symptoms and progress of ordinary acute pneumonia in children. When the inflammation is subacute, as in those forms of the disease which result from collapse or hypostasis, the symptoms are less pronounced. The respiration in such cases is but moderately accelerated, is attended by little pain, and therefore the expiratory moan is often absent. An occasional short, dry cough occurs, with so little increase of temperature and quickening of the pulse that the pneumonia is often overlooked by the physician, the symptoms being referred to bronchitis. Pleuritis seldom occurs in connection with this form of pneumonia, except when a small abscess or gangrene results in an affected lobule directly under the pleura. A few such cases I have observed.

Tubercular pneumonia extends over much or little of the lung according to the amount of the tubercules. The symptoms are like those of severe primary pneumonia, superadded to such as pertain to tuberculosis. This inflammation, when once established in the consumptive child, commonly continues till the close of life. I have sometimes had these cases under observation several consecutive weeks, even months, and during the whole time there was not only acceleration of pulse and respiration, but the expiratory moan. As regards pneumonia occurring in whooping cough, it is an interesting fact that it sometimes modifies the symptoms of the primary disease, so that during the active period of the inflammation the paroxysmal cough diminishes, and a short, hacking cough and expiratory moan occur in its place. As the inflammation abates the spasmodic cough returns. Pneumonia occurring in measles is more obstinate, protracted, and dangerous than the primary form. It usually commences about the period of the decline of the eruption, and in favorable cases continues two or three weeks. It is then a sequel rather than complication.

PHYSICAL SIGNS.—The physical signs of pneumonia in infancy and childhood are the same as in the adult, but in a large proportion of cases they are less distinct. In a majority of patients under the age of three years the crepitant râle is not observed. This is due to the small size of the alveoli at this age. I have now and then detected it in quite young children, in whom it is a finer râle than in the adult. If observed it is positive proof of the existence of pneumonia. The physical signs, therefore, in the first stage of the inflammation are often obscure in consequence of the absence of the pathognomonic râle. The vesicular murmur is somewhat intensified through the chest, and there is at this stage slight dulness on percussion over the seat of the inflammation due to engorgement of the vessels, but it is difficult to appreciate this.

In the second stage, which supervenes more or less rapidly, the physical signs are more distinct. Bronchial respiration is in most cases detected higher in pitch than the vesicular murmur, with the sound of expiration higher than that of inspiration. The voice of the patient is transmitted to the ear applied over the seat of the disease, and often a peculiar vibratory sensation is communicated to the hand applied over the part, so that it is possible to locate the disease by palpation alone. In the second stage, and sometimes in the first, coarse mucous râles in various parts of the chest are often observed occurring from coexisting bronchitis.

Percussion in the second stage elicits a dull sound as compared with that produced on the opposite side of the chest. The dulness corresponds in extent with the solidification and with the bronchial respiration.

As the inflammation abates the dulness on percussion gradually diminishes, and the bronchial respiration is succeeded by the subcrepitant râle. Often for a considerable period after convalescence is established moist râles are observed in the chest, and sometimes the dulness on percussion does not entirely disappear until the health is fully restored.

In catarrhal pneumonia these signs are commonly less distinct than in the croupous form of inflammation. This is due in part to the limited extent of the inflammation, in part, in many cases, to its subacute character, and in part to the fact that it is in many patients double, so that we lose the aid of comparison. When it results from hypostatic congestion it is nearly always bilateral.

DIAGNOSIS.—It will aid in diagnosis to recollect that under the age of three years pneumonia is ordinarily catarrhal, and that it is preceded by and associated with bronchitis. Coincident with it, and often preceding its development for a few days, are the usual symptoms of nasal and bronchial catarrh. Defluxion from the nostrils and other symptoms due to "taking cold" help us to diagnosticate catarrhal pneumonia from the essential fevers, with the exception of measles. Croupous pneumonia begins more abruptly, but in this form of inflammation the greater extent of pulmonary solidification soon gives us clear and unmistakable physical signs. The various forms of so-called remittent fever bear considerable resemblance as regards symptoms to certain cases of pneumonic inflammation, but in the latter there are more acceleration of respiration and greater suffering, especially when the child is disturbed, than in the former. The physical signs, however, afford decisive proof of the nature of the malady—to wit, dulness on percussion, bronchial respiration of a higher pitch and harsher than the normal vesicular respiratory sound, bronchophony, vocal fremitus, etc.

Difficulty sometimes attends the diagnosis of broncho-pneumonia from simple bronchitis. The presence of the expiratory moan, if it be pretty constant and marked, affords evidence that the inflammation has extended to the lungs, but the physical signs constitute the reliable means of exact diagnosis. They should be carefully noted, in order to determine if there be some point of solidification.

Solidification gives rise to dulness on percussion, bronchial respiration, and bronchophony. These three signs coexisting afford sufficient proof of pneumonia, unless there be tubercular consolidation or possibly collapse supervening on suffocative bronchitis. The history of the case aids in determining whether there be either of these diseases. Moreover, collapse occurs later after the attack commences than hepatization, and does not produce so distinct bronchophony or bronchial respiration as is observed in ordinary cases of pneumonia.

Pleuritis with effusion may present physical signs which bear considerable resemblance to those in pneumonia; but in pneumonia, except when associated with tubercular disease, the dulness on percussion is not so great as that from pleuritic effusion. In pleuritic effusion in a young child the respiratory murmur can often be heard with the ear applied over the liquid, but it is indistinct and transmitted through the liquid from a distance. The practised ear is able to discover the difference between it and the bronchial respiration of pneumonia. Vocal fremitus, which is absent in pleuritic effusions, is another reliable sign of pneumonia in children over the age of three or four years. In younger children it is indistinct. Occasionally the physical signs indicate the coexistence of the pulmonary and pleural inflammations.

In catarrhal pneumonia it is often difficult to determine certainly the nature of the disease, since the physical signs, if there be but little extent of inflammation, are absent or indistinct. I have often, in post-mortem examinations, found so small a part of the lung hepatized that it could not possibly have produced any appreciable dulness on percussion, bronchial respiration, or bronchophony. Such cases often pass for simple bronchitis, and practically this matters little, since the treatment required by the two is not dissimilar.

PROGNOSIS.—Primary pneumonia, affecting only one lung, if properly treated in most instances terminates favorably in children and even infants. If double, it is, as in the adult, much more serious, and is in certain cases fatal. Secondary pneumonia, pneumonia occurring in measles, whooping cough, tuberculosis, or resulting from hypostatic congestion in the course of some exhausting disease, is, on the other hand, more frequently fatal. As death usually occurs from asthenia, the younger the child and more feeble the constitution the greater the danger.

Unfavorable symptoms are an increase of dyspnœa, a pulse becoming more and more frequent and feeble, pallor of countenance, inability of the patient to support the head, total loss of appetite, refusal to notice or be amused by playthings, absence of tears when crying—a symptom which French writers have pointed out—and the appearance of pemphigus on the face or elsewhere.

Indications on which a favorable prognosis may be based are moderate acceleration of pulse and elevation of temperature, pneumonia primary and limited to one side, ability to support the head or sit erect, being amused by playthings, etc.

TREATMENT.—The treatment of the two forms of pneumonia—namely, catarrhal and croupous, the former occurring chiefly under the age of three years and being secondary, the latter occurring in most patients over that age—requires to be considered separately, as much as do their symptoms and anatomical characters.

Catarrhal pneumonia, when developed from and upon a bronchitis, as it so often is, requires for the most part the continuance of the remedies which are appropriate for the primary disease. (See art. Bronchitis.) But from the fact that it is secondary and in children of tender age, and since the danger as regards the pneumonia is due to asthenia, more actively sustaining measures are demanded than are required for uncomplicated bronchitis. When the pneumonia has continued a few days, and often in its commencement, carbonate of ammonium and alcoholic stimulants are needed, and the diet from the first should be nutritious. In that form of catarrhal pneumonia which is due to passive congestion or hypostasis, in the causation of which debility is an important factor, tonic and stimulating measures are still more imperatively required. Frequent change of position is useful in such cases.

In *croupous pneumonia*, if seen at the commencement or within a few hours of the commencement, an emetic of ipecacuanha may be given, as recommended by Trousseau. This acts promptly as a cardiac sedative, diminishing somewhat the afflux of blood to the lungs and moderating the inflammation. It should not be employed except at the period mentioned.

The abstraction of blood by leeches or otherwise has justly fallen into disrepute in the treatment of the inflammations of children, since it is too depressing. We have in aconite, antipyrine, antifebrin, phenacetin, efficient substitutes for bloodletting, which by their sedative effect on the heart diminish the exaggerated afflux of blood to the inflamed lung, and thus enable us to meet the indication of treatment in the first stage of the inflammation. It is important in all severe cases to preserve the blood and the strength, for the danger in the end is chiefly from asthenia, and therefore the use of one of the cardiac sedatives mentioned above is preferable to the abstraction of blood.

The following prescription will be found useful in the commencement of pneumonia, when the child is restless and has the expiratory moan. It is especially useful if, in addition to the general restlessness, occasional twitchings of the limbs occur, which is a forewarning of eclampsia:

℞. Tinc. opii deodorat., gtt. xvj;
Antipyrine, gr. xvj;
Potas. bromidi, ʒj;
Syr. simplic., ℥ss;
Aquæ anisi, ℥iss.

Shake bottle. Give one teaspoonful every two to three hours to a child of two to three years. If nervous symptoms are not prominent, the bromide may be omitted.

If bronchial respiration, bronchophony, and dulness on percussion are present, indicating the second stage of pneumonia, it is better to discontinue the use of the antipyrine or other cardiac sedative, unless the temperature reach or exceed 104°. If it do, one grain of antipyrine may still be administered every third hour to a child of two years, and two grains to one of three or four years.

The remarks made in reference to the use of quinia and digitalis for bronchitis apply with still more force to their use in both the catarrhal and croupous forms of pneumonia. In secondary pneumonia and in primary occurring in feeble children these agents are in many instances preferable to any other medicine for the purpose of reducing the temperature and pulse, since they produce this result without depression. They may be administered in such cases from the first day.

In some observations recently made (1880–81) in the New York Foundling Asylum it seemed to us probable that quinine, given in one or two large doses at the commencement of acute primary pneumonia, as five grains to a child of three years, exerts some controlling effect on the inflammation, perhaps even rendering it abortive, and that its subsequent use in smaller doses may yet supersede in great part that of the cardiac sedatives mentioned above.

When the inflammation begins to abate there is usually progressive improvement. Many now recover with simple mucilaginous drinks or mild expectorants useful for the accompanying bronchitis, as chloride of ammonium in the syrup of tolu. Others require more sustaining measures, and for such carbonate of ammonium is preferable, with, perhaps, quinia. In severe pneumonia it is of the utmost importance to sustain the vital powers, even from the commencement of the inflammation. There can be no doubt that the great error in the therapeutic management of children with this malady has been the employment of medicines which reduce the strength when gentler measures or those of a sustaining nature were needed. Alcoholic stimulants are required sooner or later in most cases at an early period in feeble children and in secondary forms of the inflammation. Infants may take three or four drops of Bourbon whiskey or brandy for each month of their age every two or three hours. The diet should be nutritious, consisting of milk, animal broths, and the like, unless during the first three or four days in robust children.

The bowels should be kept open as an important part of the treatment of croupous pneumonia in its first stages. A small dose of castor oil, Rochelle salts, or citrate of magnesia should be given if there be any tendency to constipation, and repeated from time to time if required. A saline aperient by its derivative and refrigerant effect in some cases obviates the necessity of employing cardiac sedatives. A laxative enema is preferable for a feeble child and in most cases of secondary pneumonia.

Local treatment is required in all cases; counter-irritation should be produced as soon as possible over the chest by mustard or some stimulating liniment, and, except at the time of this application, the chest should be constantly covered with an emollient poultice or with a cloth wrung out of warm water and covered with oil-silk. I prefer, however, the constant application, under the oil-silk, of the following poultice, made large, but as thin as the pasteboard cover of a book, and therefore light:

℞. Pulv. sinapis, ℥ss;
Pulv. semin. lini, ℥viij. Misce.

Vesication, in my opinion, very rarely expedites the cure or benefits the patient. The ordinary fly-blister should never be employed; and if it be thought best to vesicate, cantharidal collodion should be prescribed for this purpose. A safe, almost painless, and at the same time efficient, mode of applying this is in spots as large as a ten-cent piece, half a dozen, more or fewer according to the extent of the inflammation, the skin of course remaining sound between them. This mode of application obviates the danger of producing a troublesome sore which sometimes occurs in children from the ordinary mode of vesication. I have, however, entirely discarded vesication in all forms of pneumonia.

In *cheesy pneumonia*, which is always accompanied by anæmia and great reduction of the vital powers, carbonate of ammonium with citrate of iron and ammonium equal parts, or cod-liver oil administered three times daily with two drops or more of syrup of iodide of iron, will be found useful, as is also quinine with iron. Patients require the most nutritious diet and alcoholic stimulants. In the local treatment of this form of inflammation vesication, even so mild as that by cantharidal collodion, should be avoided. Recently in protracted cases of pneumonia attended by wasting, for the purpose of destroying the tubercle bacillus if it have obtained a lodgment in the lungs, there has been recommended the inhalation from a sponge several times daily of the vapor of the following mixture:

℞. Creasoti (Merson's), ʒij;
Terebene, ℥iij. Misce.

Add 25 drops to a sponge, and place it near the nose of the patient, especially in sleep.

CHAPTER VIII.

PLEURISY.

The term pleurisy or pleuritis is employed in this chapter to designate inflammation of the pleura when not produced by extension of the inflammatory process from the lung or by the irritation of tubercles upon or under the pleura. Catarrhal pneumonia, common in infancy; croupous pneumonia, common in childhood; pulmonary tuberculosis, not rare in both periods in wasted and cachectic children,—are ordinarily accompanied by pleurisy, arising consecutively to the lung disease, and limited nearly to the portion of the pleura which covers the affected lobes or lobules. But since in these cases the pleuritis is subordinate to and dependent on the graver diseases, and is comparatively unimportant, it does not require separate consideration. It is properly treated of in our books in connection with and as a part of those diseases. All other cases of pleuritic inflammation, although presenting wide differences in form and clinical history, are embraced under the general term *pleurisy*.

Frequency.—Pleurisy was formerly supposed to be rare in young children. Even M. Barrier of Lyons, the author of a creditable treatise on diseases of children, wrote as late as 1860: "Ainsi donc, en généralisant les faits de Vallieux et les nôtres, nous pouvons dire: que la pleurisie, depuis la naissance jusqu'à l'age de six ans environs, ne constitue presque jamais une affection simple, unique, et independante de la pneumonie." But greater precision in the examination of cases, more accurate means of diagnosis, more knowledge of the nature of diseases, and more frequent autopsies have enabled the profession to correct this as well as many other errors, and it is now known that primary pleurisy is not infrequent in young children, even in infants. In asylums and hospitals for children, in which institutions the nature of diseases is more accurately ascertained than in private practice—for autopsies are made in the fatal cases—the frequency of pleurisy in its various forms—latent, semi-fibrinous, and purulent—is surprising to those whose knowledge of the disease has been acquired only through private practice. Thus, in the New York Foundling Asylum in the seven months from April 1 to November 1, 1879, while there were 35 cases of bronchitis, 21 of pneumonia, and 3 of tuberculosis, there were 11 clearly-ascertained cases of pleurisy. There can be no doubt that many cases of this malady in young children are mistaken by good practitioners for other diseases, especially for pneumonia, or, if the pleurisy be to a certain extent latent, for remittent or malarial fever or fever due to intestinal irritation. I have records of several cases occurring in family and hospital or asylum practice in which children perished with a wrong diagnosis or without diagnosis, when the post-mortem examination revealed pleurisy, sometimes of long standing. Thus in one case of fatal empyema, commencing at the age of six months and continuing several months, chronic pneumonia had been diagnosticated by physicians known [illegible] thorough in their examination and usually accurate. In another ca[illegible] proved fatal at about the age of one year, the child, who lived in [illegible] for weeks under treatment for supposed malarial [illegible] gnosis was easy, for at my first visit, which was [illegible] there was decided dulness on percussion over [illegible] In this case the right lung was adherent to the ribs anteriorly and laterally, while posteriorly it was separated by pus, which crowded forward the organ so that its posterior surface was concave.

In wards of institutions and in the crowded quarters of the poor pleurisy appears to be more frequent than in families in comfortable circumstances. Its frequency varies also in different years according to the presence and prevalence of its causes. Thus during epidemics of scarlet fever it is more common than at other times.

During several weeks immediately preceding May, 1874, when there was no unusual prevalence of the causes or conditions which give rise to pleurisy, I noted carefully the character of the sickness in 404 consecutive cases under the age of twelve years in private practice, and of these, 2 had primary pleurisy, or ½ per cent. This is probably about the usual proportion of pleurisies in children in family practice, except when scarlet fever is prevalent.

I have preserved the records of 56 cases of pleurisy in children under the age of twelve years, most of them occurring in the institutions which I am attending or have attended as physician, and the remainder in private practice. The statistics of these cases, embraced in the following table, are interesting, as showing the frequency of pleurisy, and pleurisy of the suppurative form, in young children. The large number of empyemas seen in the table does not, however, indicate the true proportion of suppurative to sero-fibrinous pleurisies, since protracted and stubborn cases, which are largely empyemas, are more frequently brought to institutions for treatment than are those of a milder and more manageable type. Thus, in the class of children's diseases in the Bureau for the Relief of the Out-door Poor, a large percentage of the cases are empyemas which have resisted treatment elsewhere. Besides, pleurisy with little exudation is sometimes latent or so mild that it is overlooked or not diagnosticated even by physicians who are thorough and careful in their examinations, and I do not doubt that such cases have occurred in the institutions and in my private practice during the time in which my statistics were collected:

Age (49 Cases).

Under Two Months.	From Two to Six Months.	From Six to Twelve Months.	From One Year to Three Years.	From Three Years to Six Years.	Over Six Years.
3; all empyemas; 1 double.	15; 9 at least empyemas—7 on right side, 4 on left side, 4 double.	2; both empyemas—1 right, the other left.	13; 8 right, 5 left. Exudation in some sero-fibrinous; in others purulent	10; 7 right, 3 left. Exudation in some sero-fibrinous; in others purulent.	6; 5 right, 1 left; 1 empyema.

CAUSES.—Primary pleurisy in the child has heretofore been attributed to that common cause of inflammations, "taking cold." It is often most common in times of changeable temperature. Cachexia is an acknowledged predisposing cause, so that children whose blood is impoverished, whether from previous disease or from antihygienic influences, are more liable to this infl[illegible]ion than those who possess a sound and vigorous constitution. [illegible]eration of this cause a larger proportion of cases occur among [illegible] of the city poor than among those who are well nourished and [illegible] comfortable circumstances, since the cachectic and ill-cared-for [illegible] more exposed, but are less able to resist noxious agencies.

Pleurisy is not rare in new-born infants, and its cause when thus occurring is not always apparent. It may sometimes be heedless exposure to cold or to currents of air by the nurse, but the common cause at this age is believed to be the absorption of septic matter.

Billard, whose observations were made among foundlings in the Hospice des Enfants Trouvés, says: "Pleurisy is more common among young infants than is generally supposed; it often appears without the lungs participating in the inflammation. I have seen several infants die immediately after birth from this affection." He relates two cases of double idiopathic pleuritis ending fatally at the ages of two and ten days (*Diseases of Infants*, page 419). Mignot, whose observations were made in the same institution, also records 16 pleurisies, 5 of which were idiopathic, in 119 dissections of new-born infants (*Maladies pendant le Premier Age*).

Cases like the following are not infrequent:

In 1867, I made the post-mortem examination of a foundling who died in the New York Infant Asylum at the age of about one month. On each side of the thorax, the pleura, costal and pulmonary, was uniformly injected, and a small amount of pus, not more than one drachm, was found in one pleural cavity, and a still less quantity of pus in the other, with little or no serofibrinous exudation. There was also pus at the root of each lung, lying not entirely upon the free surface of the pleura, but partly underneath it.

The fact of a double pleurisy without disease of the lungs, which might produce it, indicated a constitutional cause. Its system had probably become infected by the absorption of septic matter from the umbilical vessels.

One of the eruptive fevers, scarlatina, not infrequently produces pleurisy, occurring as a complication or sequel. This result seems to be sometimes due to septic matter in the blood resulting from the action of the scarlatinous virus. In other instances it is possibly the result of retained urea consequent on scarlatinous nephritis, for pleurisy is a common complication of Bright's disease, due, it is supposed, to the irritating property of urea, which is excreted upon the pleural surface. Pleurisy in young children is sometimes also caused by the discharge into the pleural cavity of some morbid product, as pus, softened tubercle, or decomposed lung-tissue, which from its highly irritating effect causes intense and general inflammation of the pleura. I have observed several such cases.

Thus, in November, 1866, an infant of three and a half months died of pleurisy occurring upon the left side. The left lung was firmly bound down by adhesions, so as to be reduced to about one-sixth its normal size. On attempting inflation of this organ when it was removed from the body, air escaped from a small opening in the middle of the upper lobe, and around this opening the lung-substance was of a dark reddish color, softened and disintegrated. It seemed probable from the appearance that there had been hypostatic congestion, or perhaps pneumonia, in the posterior part of the lung, and that the loss of vitality and softening had occurred from the sluggish or suspended circulation in the part, and that the fatal pleurisy had resulted from a little of this decomposed tissue entering the pleural cavity.

A case having apparently a similar origin occurred in the New York Foundling Asylum in October, 1879:

An infant aged five months and a half became suddenly and severely sick with pleurisy on the right side, and died in five days. On opening the pleural cavity, air escaped. The record of the examination states: "In about the middle of the posterior surface of the lower lobe was an opening which admitted the tip of the little finger to the depth of one-fourth to one-third inch. The lung-tissue seemed to be disorganized and of pultaceous consistence around the cavity. Through this cavity, which communicated with a bronchial tube, the air had escaped, which was noticed on opening the chest."

Occasionally we meet cases, especially in foundling asylums, in which the cause is different from the foregoing, but in some respects similar. An indolent pneumonia occurs over a circumscribed area in the posterior part of the lung, either from hypostasis or exposure to cold. Minute abscesses form in the inflamed parenchyma, not larger than pins' heads or small shot. Perhaps they are located in bronchioles, and are produced by the accumulation of muco-pus, which collects in these tubes, and is not expectorated on account of the low vitality and feeble functional activity of the tissues concerned. These abscesses approaching the pleural surface produce a circumscribed pleurisy of small extent; and finally one, probably in some sudden movement of the lungs, as in crying or coughing, breaks into the pleural cavity, causing general purulent inflammation. The following was such a case:

In May, 1859, a male infant aged two months was admitted into the Nursery and Child's Hospital. He was delicate, and had what was diagnosticated a mild bronchial catarrh; but by wet-nursing his general condition gradually improved. In July, however, he had repeated attacks of diarrhœa, and progressively lost flesh and strength. On August 3d his respiration became suddenly accelerated and painful, and death occurred from dyspnœa and exhaustion. No cough or other symptom referable to the respiratory apparatus had been observed previously to the day of death.

At the autopsy the intestines were found to present the usual lesions of intestinal catarrh of the summer season. The right lung was compressed by a sero-fibrinous exudation, though, from the small size of the pleural cavity, the quantity of exuded liquid was not more than two ounces. Nearly the entire right pleura, visceral and parietal, was covered with fibrin of a creamy appearance, and there were loose flocculi in depending portions of the cavity. This lung could be inflated, except a little of the lower lobe, which was hepatized. The left lung also occupied a very small space, being partially collapsed. It could be readily inflated, when it appeared normal, except a small portion in the posterior aspect of the lower lobe, which was partially covered with lymph, and was found to contain two abscesses, one closed and the other opening externally on the surface of the lung and connecting internally with the bronchial tube. On attempting inflation air passed directly through this opening. The closed abscess contained from one-third to one-half a drachm of pus and disintegrated lung-tissue, as shown by the microscope.

Another case, showing a similar cause of pleurisy, occurred in a female infant of about four months, in the same institution, in November, 1869:

She was admitted in October, somewhat reduced from diarrhœa, but her health improved partially, though she remained feeble, and the records state that she was much troubled with meteorism and occasional pain. On November 2d she was suddenly seized with great dyspnœa, and died in about fifteen minutes. No cough had been noticed or other symptom referable to the chest, but there can be little doubt that the occasional symptoms of pain referred to in the notes were due to the pleurisy. The body was much emaciated, and depending portions showed hypostatic congestion: right lung adherent to diaphragm and to a considerable part of the costal pleura by fibrinous exudation; this lung was somewhat compressed and non-crepitant; its upper lobe floated in water, while its middle and lower lobes sank and could be only partially inflated; this portion of the lung contained a few small superficial abscesses, each holding scarcely more than one drop of pus; two of these were empty, and air passed through them on attempting inflation. They probably, one or both, opened into the pleural cavity during life, but possibly they were opened in separating the adhesions which united the two pleural surfaces at this point; the pleural cavity contained from two to three ounces of liquid, consisting mainly of pus and fibrinous shreds.

A similar case occurred in the New York Foundling Asylum, in October, 1879:

The patient, aged four months, began to be sick October 11th, having the characteristic symptoms, and died October 15th. The right pleural cavity contained about ℥iij of sero-purulent liquid, pressing the lung forward and toward the median line. In the posterior surface of the right lower lobe, near its base and immediately under the pleura, were three or four small abscesses, each not larger than a small drop of pus, and two or perhaps three of these had ruptured, so that air escaped from them on attempting inflation, while one was closed, the pus in it being visible under the pleura.

This cause of pleurisy—namely, the bursting of a minute abscess in the lung—and that in which a portion of the lung loses its vitality, disintegrates, and enters the pleural cavity, are probably not frequent, except in the first months of infancy in wasted and ill-conditioned infants in families of the city poor and in the asylums.

A peripharyngeal abscess, descending along the œsophagus, has been known to cause fatal pleuritis by bursting into the pleural cavity, and pus from carious vertebræ has produced the same result. In January, 1864, I presented to the New York Pathological Society the lungs of an infant whose history was as follows:

R——, aged nine months, of strumous parentage, and whose only sister had suffered severely from strumous ophthalmia and periostitis, was taken sick about December 19, 1863, with febrile symptoms, attended by restlessness, but apparently without any serious indisposition. On the 22d the mother called my attention to a prominence just below the right clavicle, which proved to be an abscess, and a poultice was applied over it. On the 24th the prominence suddenly subsided, and immediately the symptoms were greatly aggravated. The pulse rose to 160 per minute, the respiration from 60 to 80, and expiration was accompanied by a moan, indicating acute pleuritic inflammation. Within forty-eight hours after the disappearance of the swelling and the exacerbation of symptoms dulness on percussion over the right side of the chest was observed, and this increased till it was complete from the clavicle to the base of the thorax. The acceleration of pulse and respiration continued, the patient grew more and more feeble, and death occurred December 31st.

On dissecting away the integument from the right side of the chest an abscess was opened containing nearly one ounce of pus, located at the point where the tumor had been observed. At the base of this abscess, between two of the ribs, was a small round opening, not much larger than a knitting-needle, leading directly into the cavity of the chest, so that on depressing the ribs liquid flowed from the pleural cavity. On removing the sternum the liquid was found to be sero-fibrinous, with considerable pus in depending portions of the pleural cavity.

I have met one other, apparently almost identical, case, occurring in an infant of seven months.

Pleurisy in the adult is sometimes the result of violence. The most notable and unequivocal cases having this origin are those in which the ribs are fractured. It rarely happens that we can attribute the pleurisy of children to this cause. I can recollect only one case in which the inflammation seemed to be due to violence:

In September, 1867, an infant of twenty-two months in the almshouse on Blackwell's Island, having had a cough half a year and being somewhat reduced, fell from bed, striking against the left side of the thorax. Severe pleuritic symptoms supervened, and the child died of empyema in three and a half weeks. More than a pint of pus was found in the left pleural cavity, pressing the heart beyond the median line and the diaphragm downward, so that it was convex toward the abdomen. The bronchial glands were hyperplastic and slightly cheesy, and a caseous nodule lay in the anterior surface of the right lung, which seemed otherwise healthy. The left lung, bound down by adhesions, could be partially inflated. Whether or not it contained small tubercles is not stated in the records.

The occurrence of the injury just before the commencement of the pleurisy may indeed have been a coincidence, but the mother constantly believed that the fall caused the inflammation, and there was no other assignable cause.

It is probable, from the history of this case and the lesions, that the cheesy degenerations antedated the fall, and that the pleura was in an abnormal state and prone to inflammation when the injury was received.

The etiology of pleurisy in children differs, therefore, from that in adults. Certain causes are the same; but others, as scarlet fever and irritating products generated in the walls of the chest and bursting into the pleural cavity, are not rare in infancy and childhood, while they seldom occur in adults.

Histories of cases like the above strengthen the belief that pleurisy in children frequently, and perhaps usually, has a microbic origin. This belief also receives support from the researches of Dr. Henry Koplik of New York. An interesting and instructive paper detailing his investigations was read before the American Pædiatric Society, June 4, 1890. He has kindly furnished me the following résumé of this paper:

"My methods of investigation were strictly in accord with those of the Koch school, and the results attained in the above cases correspond closely to those of the above authors in the adult subject. The twelve cases could be divided from a bacteriological standpoint into four groups. The first group includes those cases in which the examination of the pus of the empyema yielded either the streptococcus pyogenes or the staphylococcus pyogenes aureus. The etiology of this set of cases is still obscure. The exact source of these micro-organisms is still a matter of speculation. Whether we agree with Weichselbaum, and assume that the empyemas may follow a pneumonia (?), or that these organisms, being present in the subpleural tissues, may be enabled to become potent through such a predisposing agent as cold or a slight traumatism, the etiology for the present is veiled in doubt. The micro-organisms found are not characteristic. The second group of cases includes the empyemas of pneumonic character. They are those in which the diplococcus pneumoniæ (Fränkel and Weichselbaum) is found in the purulent exudate. In seven cases of the above series this micro-organism alone was found in the pus withdrawn from the chest. It was in uncontaminated form, and when cultivated in pure culture and inoculated upon animals results were attained identical with those of Fränkel and Weichselbaum. The isolated presence of such a virulent micro-organism in a pure state in the pus of an empyema must lead to the inevitable conclusion that a pneumonia in the lung had preceded or complicated the empyema. In two cases of the above seven the pleural exudate, though at first quite serous in character, contained the diplococcus pneumoniæ. These cases subsequently developed into well-marked empyemas. The pus in the empyemas also contained only the diplococcus of Fränkel and Weichselbaum.

"The third group includes those cases in which the processes are of a tubercular nature. There is only one case of this group to report—a boy æt. eight years. The tubercle bacilli were found in the pus by cover-glass stain only. Experiments upon animals have thus far proved negative. The pus in this case was contaminated with streptococcus pyogenes. The patient is still living at the time of writing, but the lung has not expanded on the affected side. There are no physical signs in this case of lung tuberculosis in the lung of the healthy or affected side of the chest.

"The fourth group of empyemas includes those cases in which a focus of suppuration outside of the chest can with probability be fixed upon as a source of infection and as the direct cause of the empyema. In the above twelve cases only one, an infant æt. four months, could be classed in this group. For two weeks preceding the chest trouble the patient had suffered from a deep burrowing abscess of one foot. The study of the pus from the chest yielded a pure culture of streptococcus pyogenes. A pure culture of this injected into animals proved very virulent and fatal. The little patient died quickly, even in spite of operation for the relief of the empyema."

ANATOMICAL CHARACTERS.—In the commencement of pleurisy the subpleural blood-vessels, lying in the connective tissue, and the capillaries of the pleura are engorged with blood, producing vascular points and arborescence, seen through a magnifying-glass of low power. Frequently in children, as in adults, minute extravasations of blood, resulting from extreme congestion, occur under the endothelial layer, scarcely perceived by the naked eye, but readily seen under the glass. Immediately exudation of liquid holding numerous cells begins in the connective tissue which surrounds the capillaries; the pleura becomes dry and lustreless, while the production and exfoliation of its endothelial cells are greatly increased. These no longer present their normal appearance, but are swollen and granular in consequence of the inflammation.

Immediately after these parenchymatous changes occur, serum, fibrinogenic substance, and leucocytes begin to exude upon the free surface of the pleura. The term fibrinogenic substance, instead of fibrin, is employed, because it is now believed that fibrin itself is not exuded, but a substance which becomes fibrin through the presence and action of certain agents with which it comes in contact, among which may be mentioned air, red blood-corpuscles, and even serum, from which fibrin has been precipitated (Virchow, Cornil, Ranvier, and others).

In the exuded liquid, even if it have the appearance to the naked eye of ordinary serum, the microscope always reveals the presence of pus-cells or leucocytes and red blood-cells, however small their quantity may be. The minute rootlets of the lymphatic system, which are interspaces or lacunæ in the subpleural connective tissue, and which here and there open by stomata upon the pleural surface, are clogged by inflammatory products and their walls swollen at an early stage (E. Wagner and others). In these lymphatic channels both pus-cells and coagulated fibrin are seen by the microscope. That pneumonia, whether catarrhal or croupous, seldom occurs in superficial parts of the lungs without causing inflammation of that portion of the pleura which covers the affected lobules is universally known; but the reverse is also true, that pleurisy seldom occurs without causing inflammation of the alveoli which are adjacent to the inflamed membrane. The pneumonia thus caused is so superficial that it is very liable to be overlooked at the post-mortem examination in the presence of the graver lesions of the pleura; but a knowledge of its occurrence is important in diagnosis, for, though it may have no greater depth than a line, it is sufficient to produce crepitant râles like those in ordinary pneumonia. Therefore, if we hear these râles, we may mistake the disease for pulmonary inflammation and overlook the pleurisy—an error not unusual in the treatment of children.

Trousseau, who surpassed most of his contemporaries as a clinical observer, wrote: "This sound, which is met with in the great majority of cases of pleurisy, is in fact a crepitant râle, and I have called it a crepitant râle of pleurisy. My interpretation is very simple. Just as we never have erysipelas without engorgement of the cellular tissue, there cannot be erysipelas of the pleura or pleurisy without an irritative engorgement of the subpleural cellular tissue or of the peripheric pulmonary parenchyma. This fluxion naturally carries with it into the pulmonary vesicles a serous exudation. . . . . We also meet with a fine subcrepitant râle, which is very often heard quite at the beginning of pleurisy, and which likewise nearly always continues for some weeks." More recent observers and writers fully agree with the statement of Trousseau, except that what he designates irritative engorgement the microscope shows to be a true inflammation of the pulmonary alveoli.

There are four constituents of every pleuritic exudation—to wit, serum, fibrin, red blood-corpuscles, and leucocytes or pus-cells; which last are identical in appearance with the white blood-corpuscles and the lymph-corpuscles, and the origin of which has been investigated by many microscopists. It is convenient to classify cases of pleuritis according to the quantity and relative proportion of these constituents, as follows: 1st. The plastic, sometimes designated dry or adhesive; 2d. The sero-fibrinous; 3d. The purulent; 4th. The hemorrhagic.

1. **Plastic Pleurisy.**—In cases which pertain to this group the inflammation is chiefly parenchymatous, either no exudation occurring upon the free surface of the pleura, or if any, whether fibrin, pus, or serum, it is so slight that it possesses no clinical importance. The essential anatomical changes in this form of pleurisy, as regards the pleural surface, are rapid proliferation, retrogressive change or decay and exfoliation of the endothelial cells, and the sprouting out of granulations which develop into connective tissue. In plastic pleurisy there is no compression of the lungs, and the pleural surfaces are separated from each other only by the granulations, which soon unite with those of the opposite surface. This form of pleurisy is not infrequently latent in children, for at the autopsies of those who have died of various diseases we often observe bands of connective tissue uniting the opposite pleural surfaces, when the parents or nurses cannot recall to mind any sickness or symptoms such as pleurisy commonly causes. It is certain also that plastic pleurisy is often overlooked when not latent, the fever and other symptoms being attributed to causes quite distinct from the true one. The symptoms and physical signs are obviously less pronounced in this than in other forms of pleurisy.

2. **Sero-fibrinous Pleurisy.**—This is the most frequent of all. It is the pleurisy which is usually thought to result from catching cold. The serum exudes from the capillaries of the inflamed pleura in very variable quantity in different cases, and the pleural surface is soon covered with a fibrinous layer. This may be a mere film or it may attain the thickness of half an inch or more. It is usually at first slightly attached, but afterward, from being blended with the granulations, it may be firmly adherent. In some cases it is quite compact, while in others it has a loose areolar texture, containing in its interstices serum and pus-cells. The fibrin is for the most part deposited on the pleura, but shreds and flakes of it also float in the serum. In the serum, as well as entangled in the fibrin, we find not only red blood-cells and leucocytes, but endothelial cells thrown off from the pleura, which, as well as those still adherent, are almost always in process of degeneration and decay.

If a perpendicular section be made through the pleura, in this as well as in the other forms of pleurisy many newly-formed cells, the lymph-corpuscles, are observed in the meshes of the subpleural connective tissue, and, as we examine the section nearer to the surface of the pleura, these cells are seen to be aggregated in masses and held together by a structureless, homogeneous matrix. The lymph-corpuscles appear to be the active agents in the formation of granulations. They are observed in various stages of transformation from the round to the spindle-shaped. The prolongations of the spindle-shaped cells unite with each other, so as to form the connective tissues, capillaries, and other elements of the granulating surface. That the endothelial cells take no part in the production of the new tissue is inferred from the fact that most of them present the appearance of retrogressive change and decay. The granulations, as they sprout out from the pleura, become intimately blended with the fibrinous exudation, and when the effused liquid is absorbed they unite with those of the opposite pleural surface, forming an organic union, by blood-vessels and nerves, between the lung and parietes, the lung and pericardium, or different lobes of the same lung, as the case may be. They pass in two or three weeks from embryonic to perfect tissue, vessels and nerves grow in them, and they possess henceforth all the properties of living tissues; they are able to absorb; they are liable to inflammation and hemorrhage, and may, in fine, participate in all the alterations of the organism of which they are a part (Jaccoud).

3. **Purulent Pleurisy.**—Although, as stated above, pus-cells are always present in the pleuritic exudation, we designate the disease purulent or empyema when the cells are so numerous as to render the liquid turbid. If there be cloudiness appreciable to the naked eye and due to the pus-cells, the case is regarded as one of this form of pleurisy. Purulent pleurisy is at first, in a large proportion of cases, sero-fibrinous, becoming purulent after some days or weeks—a fact readily ascertained by the use of the hypodermic syringe at different periods. In other instances the pleurisy is purulent from the first. Pleurisy is in family and in hospital practice more frequently purulent in children than in adults, and in ill-conditioned children than in those who are robust. It is therefore apt to be purulent in one who has had an exhausting disease, as scarlet fever, and in the cachectic children who reside in or are brought to institutions for treatment. Thus, in the New York Foundling Asylum in 1879 an infant aged two months and three days became feverish, and had the expiratory moan and hurried respiration characteristic of pleurisy. On the fourth day Dr. Reynolds, who was in attendance, inserted the hypodermic syringe and filled it with thin pus. This was, apparently, a case of primary idiopathic empyema. Pleurisy is purulent when it is produced by the entrance of some irritating substance into the pleural cavity, as pus or decomposed lung-tissue.

The production of pus in the pleural cavity is often surprisingly rapid, for, when many ounces have been removed by the aspirator, nearly the original quantity is sometimes restored within two or three days. As Fräntzel says, it does not seem possible that so many pus-cells, which must surpass in numbers the aggregate of the white blood-corpuscles, could wander from the blood-vessel in so short a time, so that we must look for some other source of the immense production of leucocytes, in addition to that discovered by Cohnheim. A large part of the pus-cells is, in all probability, produced by rapid segmentation of the lymph-corpuscles. In two cases of purulent pleurisy, occurring in infancy, I found pus underlying the pleura near the hilus, without apparently any loss of integrity in the pleura, in such quantity that it was immediately recognized by the naked eye. Pus under the pleura, as well as in the pleural cavity, was apparently due to unusual olence in the inflammation and rapid production of leucocytes.

4. **Hemorrhagic Pleurisy.**—This is not common. I recall but one case, a child, in whom the pleurisy occurred as a sequel of scarlet fever. The fluid several times removed by the aspirator had a deep reddish-brown color. I was apprehensive that the point of the aspirator, by wounding the granulations, had caused the hemorrhage which stained the pus removed at each subsequent operation. But, with the care exercised and the great amount of blood-stained exudation, it seems almost certain that this was not the true explanation, and that it was a genuine case of hemorrhagic pleurisy.

Hemorrhagic exudation in the pleurisy of children is sometimes due to purpura hæmorrhagica, being like the other hemorrhages a symptom of the general disease. In other cases it signalizes the commencement of a new inflammation in the vascular granulations of a previous pleurisy. Occurring under such circumstances, it is due to the increased fluxion in the numerous delicate capillaries of the granulations. Pleurisy due to cancerous or tubercular formations in or upon the pleura is sometimes hemorrhagic. Jaccoud says: "A sero-fibrinous or purulent exudation may be red by the transudation of hæmatin, without true hemorrhage; . . . . the red exudations which have been observed in scorbutus and marsh cachexia are really due to these pseudo-hemorrhages." In those cases in which there is true hemorrhage, it is still uncertain whether rupture of the capillaries or a transudation ordinarily occurs, or whether the blood-cells may not escape in both modes.

A liquid pleuritic exudation, whether sero-fibrinous or purulent, obviously produces an important mechanical effect from its location. In young children, especially those enfeebled by sickness, the expansive power of the lung is slight, so that it readily yields to pressure applied to its surface, and becomes more and more compressed as the liquid accumulates. Except when retained by adhesions, the lung is pressed toward the mediastinum, and at the same time carried forward and upward. Patients with pleurisy usually lie on the back and affected side, so that gravitation determines to a considerable extent in what part of the pleural cavity the liquid will collect. In the considerable number of post-mortem examinations which I have witnessed of children who perished from pleurisy, chiefly empyema, the lung was usually attached anteriorly to the thorax from the mediastinum outward, as far as the costo-chondral articulations, or farther, except in the lower part of the cavity, where there were no adhesions or adhesions only near the mediastinum. There were also attachments along the mediastinum, and attachments more or less firm on all sides, anteriorly, laterally, and posteriorly, in the upper part of the pleural cavity, toward which the lung was compressed. Many variations occur, depending on the amount of liquid and the extent of the adhesions; but, judging from autopsies which I have seen, I would say that in the average in cases so severe that the question of operative interference arises, if we draw a line from the axilla downward and forward to the epigastrium, the lung is adherent to the thorax over the space anterior and internal to this line, while external and posterior to it the liquid separates the lung from the ribs. This fact is important, as indicating the proper point for puncturing the chest—namely, below the lower angle of the scapula and between the eighth and ninth ribs. One reason why the earlier performers of thoracentesis were so unsuccessful was that they selected the anterior wall of the chest as the point of operation. Now-a-days, however, no one would be justified in performing thoracentesis unless he first employed the hypodermic syringe and removed fluid at the point which he selects for the puncture. The statistics of Mohr relating to lung displacement in empyema, chiefly statistics of adult cases, are somewhat different from my general recollection of cases occurring in infancy and childhood, as stated above. In 23 cases he found the lung free from adhesions and compressed against the vertebral column and the mediastinum; in 13 cases the organ was compressed from below upward; in 1 from above downward; in 4 from within outward; in 4 from behind forward; and in 4 from before backward. These variations depend on the adhesions which the lung happens to contract. Perhaps a point a little external to the perpendicular, passing through the angle of the scapula, is preferable for puncture, as I have known the lung to be adherent to the posterior wall of the chest near the mediastinum when the portion farther removed, say two inches from the median line, was separated by interposed liquid.

Sometimes the liquid is collected in multilocular cavities formed by the connective tissue, and these frequently intercommunicate. Exceptionally in children, as in the adult cases observed by Mohr, when there has been a large and rapid liquid exudation or when the disease has been violent and of short duration adhesions do not occur.

On account of the great difference in the size of the pleural cavity at different ages during infancy and childhood, the amount of liquid which produces that degree of compression of the lung which materially impairs its function varies greatly. At the age of four months three ounces produce complete collapse of lung, so that it resembles a fleshy mass (carnification). The largest amount of liquid relatively to the size of the chest in any of the cases which I have observed was about one and a half pints in the left pleural cavity in an infant that died at the age of twenty-two months in September, 1867. The heart lay chiefly to the right of the median line, and the diaphragm was convex toward the abdominal cavity. The case occurred in the almshouse on Blackwell's Island, and might in all probability have been relieved had attention been directed to it sufficiently early.

Liquid in the left pleural cavity, when considerable, presses the heart toward the mediastinum, so that the apex beat, instead of being a little internal to the linea mammalis, approaches the sternum. As the heart is carried to the right, the beat is felt under the lower end of the sternum, and with still greater increase in the effusion the pulsation is detected by the finger to the right of the sternum. If the exudation be on the right side, the displacement of the heart toward the left is, for obvious reasons, less than the displacement toward the right in pleurisy of the left side. Much external pressure upon the heart embarrasses its movements and prevents proper filling of its cavities, while the action of the organ is accelerated so as to compensate. Therefore, the pulse is quick and feeble.

In one instance in my practice the lower extremities and the portion of the trunk below the thorax became œdematous from compression of the ascending vena cava, and writers allude to cases in which other vessels and ducts, as the thoracic, were compressed so as seriously to embarrass their functions. The patient with the œdema was a boy of about four years, with empyema of the left side.

In large effusion the mediastinum is pressed against the healthy lung so as to diminish its transverse diameter, and Traube has shown that the effect of this is to increase the length of the lung or its vertical measurement. Consequently, as the lung on the healthy side extends lower than in the normal state, the convexity of the diaphragm on this side is diminished, as well as on the affected side, where it is depressed by the effusion.

The pleura in protracted cases of empyema becomes much infiltrated, and from the growth of connective tissue which blends with it is thickened, sometimes to the extent of one or two lines. A few months since, in removing the lungs from the body of a young infant that perished of empyema in the New York Foundling Asylum, a portion of the costal pleura, two or three inches in diameter, being adherent to the lungs, was detached from the ribs. It had a thickness of fully two lines and its free surface was rough.

Occasionally the inflammation extends from the pleura to the pericardium, producing general pericarditis. I recall to mind 4 cases with this complication in which the diagnosis was verified by post-mortem examinations. All had empyema, 3 on the left, and 1 on the right side. Pericarditis, always a grave disease, is almost necessarily fatal when thus occurring as a complication of empyema. More rarely the inflammation extends from the pleura to the peritoneum. One such case occurred in my practice, the child dying of empyema on the right side, and at the autopsy we found the lesions of a localized diaphragmatic peritonitis of the right side, with a fibrinous exudation of small extent on the convex surface of the liver directly opposite to that on the diaphragm. We are indebted to Von Recklinghausen for knowledge of the mode in which inflammation is propagated from the pleura to the peritoneum, and the same explanation probably applies to its propagation to the pericardium. In the serous covering of the diaphragm, pleural and peritoneal, minute stomata have been discovered which pertain to the lymphatic system. They open upon the surface of the diaphragm, and underneath in the substance of the diaphragm connect with lacunæ or interspaces from which the minute lymphatic vessels originate. These stomata and lymphatic spaces, pervious in their normal state, are usually clogged, as has been stated above, by inflammatory products when the serous membrane is inflamed. Occasionally the inflammation traverses these lymphatic channels from one surface to the other, from the pleura to the peritoneum, thus causing by extension a circumscribed peritonitis.

The changes which the inflammatory products undergo are the following: With the abatement of the inflammation the liquid portion begins to be absorbed, though absorption is much more tardy than in non-inflammatory effusions, since the absorbents are to a great extent covered and clogged by fibrin and pus. The serum is first absorbed, and the flocculi of fibrin sink into depending portions of the cavity or become attached to the fibrinous layers or the granulations upon the pleural surface. The pus-cells and the fibrin, whether in flocculi or layers, begin to undergo retrogressive change. They become granular from fatty degeneration, liquefy, and are absorbed. Sometimes portions of these degenerated products which are not absorbed form inert caseous masses in recesses of the cavity or between the bands of connective tissue, where they remain unchanged for years. With few exceptions, those who recover from an attack of pleurisy experience no subsequent ill-effect, though the bands and patches of connective tissue are permanent.

Pus always possesses irritating properties. Decomposed and putrid pus (ichor) is very irritating. Empyemic pus, therefore, like pus in other situations, now and then produces ulceration or necrosis of the pleural surface by which it is confined, and in consequence of its destructive action it sometimes establishes an outlet by which it escapes, with relief of the patient and cure of the disease. The chest-wall is thinnest anteriorly in the inframammary region, and at this point the pus, when it makes its way through the thoracic wall, usually points and discharges. The fistulous opening thus produced continues many months, until the pleural cavity is gradually obliterated by the adhesions and the patient recovers.

By a similar destructive process in the pulmonary pleura pus occasionally escapes into the bronchioles and is expectorated. This mode of cure appears to be common in children, for my attention has not infrequently been called to the fact that children, during the progressive but slow convalescence from empyema, expectorated large quantities of muco-pus, although in some of the cases pus had been removed by the aspirator or trocar. Fräntzel makes the remark—which is fully sustained by clinical experience in this country—that although an opening is made in the lung by the necrotic or ulcerative process, so that pus escapes into the bronchioles, air does not pass from them into the pleural cavity. Pyopneumothorax is very rare in the empyema of children, except as air is admitted in the operation of thoracentesis.

As the liquid is absorbed the compressed lung ordinarily expands in proportion to the absorption, so that more and more air enters its alveoli. But frequently, in cases of long duration, the absorption proceeds faster than the expansion, so that the ribs on the affected side sink below their normal level. As a consequence, the intercostal spaces are narrowed, the shoulder is depressed, and the dorsal portion of the spinal column bends to accommodate the ribs, so as to be concave toward the affected side. It is very rarely that the deformity thus produced is permanent. Though the newly-formed bands and patches of connective tissue may so bind the lung that its return to the normal state is tardy, yet with few exceptions the alveoli one after another open to admit air, and when full inflation is attained the symmetry of the chest is restored. But there are rare cases in which the newly-formed connective tissue is firm and unyielding almost as cartilage, and lime salts are sometimes deposited in it, forming a calcareous *plaque* which invests the lung like a cuirass. An unexpanded lung with such a covering obviously can never afterward be fully inflated. I can recall to mind, however, only one case of permanent complete collapse or carnification of lung resulting from pleurisy. The inflammation, which was treated by the late Dr. Cammann, occurred in childhood, and several years afterward, when the patient reached womanhood, although the general health was good, there were physical signs of an unaërated lung and the consequent deformity (depressed shoulder and ribs and bent spinal column). Pleurisy with its granulations and retrogressive products affords one of the conditions in which tubercles are developed, so that we sometimes find at the post-mortem examination of cases which have been protracted, "miliary tubercles in the pleura, while chronic phthisis and general tuberculosis are absent" (Delafield).

From the intimate relation of the heart to the lungs this organ obviously suffers severely in every large pleuritic exudation. Total compression of a lung arrests one-half of the circulation through the pulmonary artery, except as the increased flow in the opposite lung serves for compensation. Hence in cases of large effusion which end fatally we commonly find the pulmonary artery and the right cavities of the heart distended with blood and clots, while the left cavities, having received a diminished quantity of blood, are probably empty.

SYMPTOMS.—As has been stated above, pleurisy in children is sometimes latent or attended by symptoms so mild as to attract little attention even when there has been general inflammation of the pleural surface with much effusion. Both primary and secondary pleurisy may present this form, latency being more frequent the younger the patient. In feeble, cachectic children, with blood thin and impoverished, pleuritic symptoms, as pain, dyspnœa, and fever, are less pronounced than in the robust, and hence latency is more common in the tenement-house population of the cities and in institutions than in the better walks of life. The following is a not infrequent example of latency: A feeble infant, aged five months and twenty-eight days, died suddenly in the Nursery and Child's Hospital in December, 1870. The attention of the resident physician had not been called to it, as it was not supposed to be sick, except that it was ill-nourished and its general condition bad. The nurse who had charge of the ward stated that it presented no symptom of acute disease, unless a slight cough during the three or four days preceding its death. Percussion over the right side of the chest of the corpse gave a flat resonance, and at the autopsy the right lung was found compressed, nearly or quite destitute of air, and covered by a loose fibrinous layer three-fourths of an inch thick in places, and a moderate serous exudation.

Ordinarily, acute idiopathic pleurisy in children begins quite abruptly, and with symptoms which attract attention from the first. Probably in most instances it is preceded by rigors or a chilly sensation, but this usually escapes notice, if it be present, in patients under the age of five or six years. Fever, fretfulness, and a physiognomy indicative of pain are the common initial symptoms. If the patient be an infant, the fretfulness closely resembles that produced by colic, for which I have on several occasions known it to be mistaken by the attending physician.

The symptoms of pleurisy are twofold—namely, the constitutional, or such as are common to all inflammations, and the local, or those referable to the chest. Various observers have noted the position in which patients lie in bed as indicating the seat of the inflammation. It has been stated that adults, in the commencement of pleurisy, ordinarily obtain most relief with a decubitus on the sound side, but when effusion has occurred they lie on the affected side, unless there be marked dyspnœa, which is most relieved by a semi-erect position, which allows greater descent of the diaphragm. I have not noticed that children with pleurisy prefer any fixed or uniform position, except there be marked dyspnœa, which may prompt them to elevate the shoulders. The patient in the acute stage is commonly quiet when he lies in the position which he selects, and if disturbed from it becomes more fretful, his cough more frequent, and his suffering apparently increased.

In ordinary cases the temperature rises on the first day to 102° or 103°. If it be more elevated than this there is usually a complication. The temperature begins to abate when the exudation has occurred. In suppurative pleurisy the fever is more protracted, often continuing for weeks or months, presenting, after the acute stage has passed, the characters of hectic fever, with morning abatement and evening recrudescence. In weakly and anæmic children, even when the pleurisy is pretty severe and most of the usual symptoms are present, the temperature may be but slightly elevated. Thus in one of the institutions with which I am connected, in a young infant whose fretfulness was during the first twenty-four hours ascribed to colic the axillary temperature during the first three days never rose above 100°.

The pulse in the acute stage is usually between 100 and 130 per minute, but in young children who are restless it is often more frequent than this during the first week. It is accelerated as long as the temperature is elevated, but in sero-fibrinous pleuritis after exudation has occurred its frequency diminishes unless the heart be compressed. Compression and imperfect or partial filling of the cavities of the heart produce a feeble and rapid pulse. In empyema the pulse is accelerated as long as pus is confined in the pleural cavity, unless its quantity be small.

Headache, usually frontal, is frequent during the febrile stage. Convulsions, which occasionally occur in the beginning of pneumonia, are rare. Pain in the chest on the affected side is common, and is therefore a valuable diagnostic symptom, but it is often so slight as to be overlooked in infants and feeble children. It is increased by movements of the chest-walls, as in full inspiration, by coughing, and when pressure is made by the fingers in the examination. Its common seat is between the fifth and eighth ribs, external to the linea mammalis, but there are many cases in which the pain is referred to some other part, as the infraclavicular, mammary, inframammary, or even the scapular or infrascapular, region. Rarely, it is referred to the epigastric or umbilical region, or even, it is said, to some point upon the sound side of the thorax. This location of the pain at a point distant from the seat of the inflammation is attributable to the anastomosis of the intercostal nerves with those of the opposite side of the chest or with those which ramify in the abdominal walls.

The pain of pleurisy, as it ordinarily occurs, has received different explanations. It has been attributed to tension of the pleura, to friction of the pleural surfaces on each other, and to extension of the inflammation to the neurilemma of the minute nervous branches of the pleura. All these causes apparently act in producing it, but the persistent pain in the first days of pleurisy, though increased by motion, is probably due in great part to that last mentioned. Pleuritic pain is sharp or stitch-like. It begins to abate in a few days, and in a large proportion of cases ceases by the fifth or sixth day, or is no longer noticed except in coughing or during sudden movement of the chest.

The respiration is accelerated, as in all febrile diseases, but it is more rapid than in inflammatory ailments which do not involve the thoracic organs, on account of the pain experienced on full inspiration. The patient instinctively avoids full inflation of the lungs, and the breathing is consequently rapid, to compensate for incompleteness of the inspiratory act.

In ordinary attacks of pleurisy painful and hurried respiration is of short duration. It becomes easier and more natural toward the close of the first week. In subacute and chronic cases the rhythm and frequency of respiration differ but little from the normal.

A cough, whatever the form of pleurisy, is one of the earliest symptoms. It is short, frequent, and dry, and in the most favorable cases begins to diminish in the second week. A loose cough is due to accompanying bronchitis or broncho-pneumonia, or, at a late stage of the disease, to escape of pus from the pleural cavity into the bronchial tubes.

Little need be said in regard to symptoms referable to the digestive apparatus. Vomiting is common on the first and second days. Thirst, loss of appetite, and consequent loss of flesh and strength, are uniformly present. In empyema, which from its nature is protracted, nutrition is always greatly impaired. The surface presents an anæmic appearance, the flesh is soft and flabby, and the emaciation is progressive till the pus is evacuated.

PHYSICAL SIGNS.—In children above the age of three or four years, the physical signs differ but little from those in adult cases, but under this age there are certain differences which the practitioner should know. We may, in the commencement of the attack, notice diminution in the movement of the chest-walls on the affected side, since the patient instinctively endeavors to repress respiration on that side in order to lessen the pain. In severe cases the epigastrium and hypochondria are sometimes depressed during inspiration (the so-called abdominal respiration), but this sign is less common and less marked than in severe bronchitis, and when present it may be largely due to accompanying bronchitis. After effusion has occurred and the pain has abated or is slight, the respiration is less accelerated than at first, and it may be nearly or quite normal.

Inequality of the two sides produced by the liquid is more common in children of an advanced age than in those under the age of three or four years. In infants, even when there is a large liquid exudation, the bulging is often so slight that it is scarcely appreciable either by sight or measurement, and in not a few there is no apparent difference in the circumference of the healthy and affected sides. I have made measurements in infantile pleurisy during the stage of effusion, and been unable to convince myself that there was any difference, although other signs indicated the presence of an effusion which filled at least one-half the pleural cavity. I explain this fact in this way: The lungs of an infant, especially of one reduced by sickness, are very liable to a state of semi-collapse or partial inflation in their whole extent and of complete collapse of their thin borders, as of the tongue-like process of the left upper lobe, which lies over the pericardium, and of the margins of the lower lobes, which lie in the angle made by the thorax or diaphragm. This occurs in the weakly infant even when there is no obstruction to the entrance of air, and the liability to it is greatly increased by external pressure applied to the lung, as from a pleuritic effusion, so that the lung recedes, becomes compressed, and unaërated before the ribs yield to the pressure. If the exudation cease as soon as the lung is collapsed, there is little or no outward displacement of the ribs and the intercostal spaces are not elevated. It is obviously very important to know this difference between infantile and adult cases, as it has a bearing upon the diagnosis between pleurisy with effusion and pneumonia.

Palpation.—In adults and in children with strong voices, if the lung deprived of air, either by compression or an exudation within its alveoli, lie against the chest-wall, speaking or moaning produces a vibratory sensation which is communicated to the hand placed upon the chest. The fremitus is feeble or not appreciable when the voice is feeble. Therefore, in infants whose vocal cords are small, and particularly in infants reduced by sickness, this sign is ordinarily absent or so slight that it is detected with difficulty, while in older and robust children it is distinctly perceived. If the condition be otherwise favorable for the production of fremitus, but the lung be pressed away from the ribs by an intervening liquid, no vibration is felt when the patient speaks or cries. But if, in the same case, the fingers be removed to the suprascapular, axillary, infraclavicular, or mammary region, where the compressed lung comes in contact with the walls of the chest, fremitus may be perceived. Palpation also enables us to ascertain the point of apex-beat of the heart, variation of which from the normal size being one of the most conclusive proofs of a pleuritic effusion.

Percussion.—In the first hours of pleurisy there is either no perceptible change in the percussion sound, or the resonance is slightly diminished from the fact that inspiration on the affected side is resisted by the patient and the lung is only partially inflated. When exudation occurs, if there be a thin layer of liquid over the lung the percussion sound is tympanitic. It has, therefore, this quality at an early stage in the inframammary, mammary, and perhaps infrascapular regions when the amount of liquid is small, and at a later stage, when the quantity of liquid is greater, the percussion sound over the lower part of the chest is dull, while that over the central or upper part is tympanitic. Entire filling of the pleural cavity with liquid, and total exclusion of air from the lung, give rise to a dull or flat percussion sound over every part from the apex to the base. It may be stated as a rule in the pleurisy of children that at a certain stage of the effusion percussion produces a sound which is either decidedly tympanitic or which partakes of the tympanitic character. Skoda attributed the occurrence of tympanism to the fact that a lung still aërated vibrates better if surrounded by a thin layer of liquid, and consequently gives better resonance than when it lies against the chest-walls.

When the exudation is so great that the lung is totally compressed and removed to a distance from the chest-walls, the finger in percussing experiences a sensation of solidity or resistance and there is no longer any vibration of the ribs. Consequently, the percussion sound is dull or flat, as over any solid body, differing from that in pneumonia, in which there is still some vibration of the chest-walls and the dulness is not absolute. In pleurisy, therefore, there is, according to the amount of exudation, either nearly the normal percussion sound, as at the beginning of the attack and in any stage of plastic pleurisy (pleurésie séche), or a zone of dull sound below and another of tympanitic sound above, or a zene of normal resonance above and one of dull resonance at the base, with an intervening one of tympanism; or, finally, there is absolute dulness from the clavicle to the base of the chest.

It very rarely happens in the child that the level of the fluid changes by changing the position, on account of the adhesions, so that this sign, described in the books as one of great importance in diagnosis, affords very little assistance to diagnosis in children.

Auscultation.—In the beginning of pleurisy auscultation affords but slight information, except that the practised ear may detect a little diminution in the fulness of the respiratory act in the lung whose pleura is inflamed, and perhaps a slightly exaggerated respiration in the other lung. But after twelve or fifteen hours, when exudation begins to occur upon the pleural surface, we may hear the dry friction sound, which can be imitated by pushing the finger strongly across the dry palm of the hand. It is only heard in occasional cases, since the physician may not make his visit at the proper time for hearing it or he does not apply the ear over the proper place. Fräntzel says: "We shall scarcely ever fail to find the friction sound in recent pleuritis if we look for it early and diligently in some circumscribed spot." I do not think that this remark, however true it may be of adult cases, is entirely correct as regards children, for it is only in exceptional instances that it can be heard in them. It occurs both during inspiration and expiration, and it does not disappear after coughing. Being produced upon the surface of the lung, it seems near the ear of the auscultator. Perhaps it is not observed during several consecutive respirations, and then a deeper inspiration causes the pleural surfaces to glide upon each other, and it is detected. The friction sound as sometimes heard is well described by the term "scraping," and in other cases by the term "creaking," as was noticed by Hippocrates, who compared it to the creaking of leather.

In some patients it is heard for a brief period, and does not recur, and it may be detected only during strong and deep respiration or in coughing. It disappears entirely when the accumulation of liquid prevents contact of the surfaces. After absorption of the liquid the friction sound may reappear, and in certain patients it is heard only at this time—to wit, in the third stage.

An interesting and common sound heard on inspiration is the so-called *crepitant râle of pleurisy*, produced in the superficial alveoli. The remarks made by Trousseau upon it have been already given. As stated above, the inflammation extends from the pleura to the pulmonary vesicles which lie directly underneath, and as soon as exudation occurs within them the anatomical conditions are present in which the crepitant râle is produced, as in the ordinary form of pneumonia. This râle may obviously be heard before any effusion takes place upon the free surface of the pleura, and it continues until the alveoli are so compressed by the plueritic exudation that they no longer admit air.

The exudation in the pleural cavity changes the character of the respiratory sound. A thin layer of liquid over the lung causes diminution in the force of the vesicular murmur, and soon an expiratory as well as an inspiratory sound begins to be heard. This modified vesicular murmur is weak, and more distant from the ear than the respiratory sound of health. When the exudation is sufficient to close the alveoli, while the air still traverses the medium-sized bronchial tubes, we notice a tubular or bronchial *bruit*. If the small and medium-sized tubes are compressed while the air enters the large tubes, the respiratory bruit may be amphoric. Total absence of respiratory sound results from complete collapse of the alveoli and consequent exclusion of air from them, and arrest of the movements of the air in the tubes of the affected side. Jaccoud says: "Regarded as a sign of the quantity of the effusion, the modifications of the respiratory *bruit* and of the respiration may then be arranged in an increasing series, as follows: diminution of the vesicular murmur; feeble respiration (*souffle doux*); no sound and feeble respiration; bronchial respiration; no sound and bronchial respiration; no sound and cavernous respiration; general absence of sound (*silence général*). The replacement of an inferior term of the series by a superior term implies an augmentation in the quantity of liquid, and in general the passage of a superior term to an inferior term denotes a diminution of the effusion." But this statement relating to the effect upon the auscultatory sounds of the increase and decrease of the liquid must be modified as regards patients under the age of five years. In such patients it is rare, however great the effusion, that respiration is not heard when the ear is placed over the liquid. This is due to the small size of the pleural cavity, and the consequent ready transmission of sound from the centre of the thorax to its periphery. According to the amount of exudation and the degree of compression, the respiratory sound is a faint and distant vesicular, or broncho-vesicular, or bronchial murmur, and its character is found to vary from one to the other of these sounds as we apply the ear over different parts of the chest.

When the inflammation is active and the exudation occurs rapidly, bronchial respiration may be heard as early as the second or third day, or even by the close of the first day, in the infrascapular region. If, on the other hand, the inflammation be chiefly plastic or the exudation of liquid be slow and its quantity small, the respiratory murmur may be vesicular, though faint and distant, during the whole course of the attack. Sometimes when the murmur is vesicular in the greater part of the lung, broncho-vesicular or bronchial respiration is heard over a limited area, where the effusion happens to be sufficient to produce requisite compression of the lung.

The voice of the patient when auscultated over the affected side has a character which corresponds with and varies according to the respiratory murmur. Vocal resonance is feeble or absent if the respiratory murmur be vesicular. If it be bronchial, the auscultated voice is more distinct, having the character known as bronchophony, or when there is a moderate quantity of liquid over the lung, so that this organ vibrates, it may have that modification of bronchophony known as ægophony. Occasionally we can hear the voice as a confused and distant sound when the quantity of liquid is so great that respiration is inaudible. The signs derived from the auscultated voice are not, as is well known, pathognomonic of liquid effusion. Bronchophony is more common and distinct in pneumonic or tubercular solidification of lung than in pleurisy, and even ægophony may be produced without the presence of a liquid by "pleural membranes realizing certain physical conditions" (Jaccoud). But since the auscultated voice is weaker in children than in adults, we often do not hear it in infants and ill-conditioned children, even when the anatomical conditions as regard the lungs and pleural cavity are favorable for its transmission.

In children, as in adults, bronchial râles are common in pleurisy, dry or moist; coarse when produced in the larger tubes, or fine when occurring in the finer tubes.

DIAGNOSIS.—Ordinarily, a careful observance of the history, symptoms, and physical signs enable the physician to make a positive diagnosis. Obscure or doubtful cases occur chiefly in infancy. Circumscribed pleurisy or pleurisy attended with little or no liquid exudation in the other forms of pleurisy many newly-formed cells, the lymph-corpuscles, are observed in the meshes of the subpleural connective tissue, and, as we examine the section nearer to the surface of the pleura, these cells are seen to be aggregated in masses and held together by a structureless, homogeneous matrix. The lymph-corpuscles appear to be the active agents in the formation of granulations. They are observed in various stages of transformation from the round to the spindle-shaped. The prolongations of the spindle-shaped cells unite with each other, so as to form the connective tissues, capillaries, and other elements of the granulating surface. That the endothelial cells take no part in the production of the new tissue is inferred from the fact that most of them present the appearance of retrogressive change and decay. The granulations, as they sprout out from the pleura, become intimately blended with the fibrinous exudation, and when the effused liquid is absorbed they unite with those of the opposite pleural surface, forming an organic union, by blood-vessels and nerves, between the lung and parietes, the lung and pericardium, or different lobes of the same lung, as the case may be. They pass in two or three weeks from embryonic to perfect tissue, vessels and nerves grow in them, and they possess henceforth all the properties of living tissues; they are able to absorb; they are liable to inflammation and hemorrhage, and may, in fine, participate in all the alterations of the organism of which they are a part (Jaccoud).

3. **Purulent Pleurisy.**—Although, as stated above, pus-cells are always present in the pleuritic exudation, we designate the disease purulent or empyema when the cells are so numerous as to render the liquid turbid. If there be cloudiness appreciable to the naked eye and due to the pus-cells, the case is regarded as one of this form of pleurisy. Purulent pleurisy is at first, in a large proportion of cases, sero-fibrinous, becoming purulent after some days or weeks—a fact readily ascertained by the use of the hypodermic syringe at different periods. In other instances the pleurisy is purulent from the first. Pleurisy is in family and in hospital practice more frequently purulent in children than in adults, and in ill-conditioned children than in those who are robust. It is therefore apt to be purulent in one who has had an exhausting disease, as scarlet fever, and in the cachectic children who reside in or are brought to institutions for treatment. Thus, in the New York Foundling Asylum in 1879 an infant aged two months and three days became feverish, and had the expiratory moan and hurried respiration characteristic of pleurisy. On the fourth day Dr. Reynolds, who was in attendance, inserted the hypodermic syringe and filled it with thin pus. This was, apparently, a case of primary idiopathic empyema. Pleurisy is purulent when it is produced by the entrance of some irritating substance into the pleural cavity, as pus or decomposed lung-tissue.

The production of pus in the pleural cavity is often surprisingly rapid, for, when many ounces have been removed by the aspirator, nearly the original quantity is sometimes restored within two or three days. As Fräntzel says, it does not seem possible that so many pus-cells, which must surpass in numbers the aggregate of the white blood-corpuscles, could wander from the blood-vessel in so short a time, so that we must look for some other source of the immense production of leucocytes, in addition to that discovered by Cohnheim. A large part of the pus-cells is, in all probability, produced by rapid segmentation of the lymph-corpuscles. In two cases of purulent pleurisy, occurring in infancy, I found pus underlying the pleura near the hilus, without apparently any loss of integrity in the pleura, in such quantity that it was immediately recognized by the naked eye. Pus under the pleura, as well as in the pleural cavity, was apparently due to unusual violence in the inflammation and rapid production of leucocytes.

4. **Hemorrhagic Pleurisy.**—This is not common. I recall but one case, a child, in whom the pleurisy occurred as a sequel of scarlet fever. The fluid several times removed by the aspirator had a deep reddish-brown color. I was apprehensive that the point of the aspirator, by wounding the granulations, had caused the hemorrhage which stained the pus removed at each subsequent operation. But, with the care exercised and the great amount of blood-stained exudation, it seems almost certain that this was not the true explanation, and that it was a genuine case of hemorrhagic pleurisy.

Hemorrhagic exudation in the pleurisy of children is sometimes due to purpura hæmorrhagica, being like the other hemorrhages a symptom of the general disease. In other cases it signalizes the commencement of a new inflammation in the vascular granulations of a previous pleurisy. Occurring under such circumstances, it is due to the increased fluxion in the numerous delicate capillaries of the granulations. Pleurisy due to cancerous or tubercular formations in or upon the pleura is sometimes hemorrhagic. Jaccoud says: "A sero-fibrinous or purulent exudation may be red by the transudation of hæmatin, without true hemorrhage; . . . . the red exudations which have been observed in scorbutus and marsh cachexia are really due to these pseudo-hemorrhages." In those cases in which there is true hemorrhage, it is still uncertain whether rupture of the capillaries or a transudation ordinarily occurs, or whether the blood-cells may not escape in both modes.

A liquid pleuritic exudation, whether sero-fibrinous or purulent, obviously produces an important mechanical effect from its location. In young children, especially those enfeebled by sickness, the expansive power of the lung is slight, so that it readily yields to pressure applied to its surface, and becomes more and more compressed as the liquid accumulates. Except when retained by adhesions, the lung is pressed toward the mediastinum, and at the same time carried forward and upward. Patients with pleurisy usually lie on the back and affected side; so that gravitation determines to a considerable extent in what part of the pleural cavity the liquid will collect. In the considerable number of post-mortem examinations which I have witnessed of children who perished from pleurisy, chiefly empyema, the lung was usually attached anteriorly to the thorax from the mediastinum outward, as far as the costo-chondral articulations, or farther, except in the lower part of the cavity, where there were no adhesions or adhesions only near the mediastinum. There were also attachments along the mediastinum, and attachments more or less firm on all sides, anteriorly, laterally, and posteriorly, in the upper part of the pleural cavity, toward which the lung was compressed. Many variations occur, depending on the amount of liquid and the extent of the adhesions; but, judging from autopsies which I have seen, I would say that in the average in cases so severe that the question of operative interference arises, if we draw a line from the axilla downward and forward to the epigastrium, the lung is adherent to the thorax over the space anterior and internal to this line, while external and posterior to it the liquid separates the lung from the ribs. This fact is important, as indicating the proper point for puncturing the chest—namely, below the lower angle of the scapula and between the eighth and ninth ribs. One reason why the earlier performers of thoracentesis were so unsuccessful was that they selected the anterior wall of the chest as the point of operation. Now-a-days, however, no one would be justified in performing thoracentesis unless he first employed the hypodermic syringe and removed fluid at the point which he selects for the puncture. The statistics of Mohr relating to lung displacement in empyema, chiefly statistics of adult cases, are somewhat different from my general recollection of cases occurring in infancy and childhood, as stated above. In 23 cases he found the lung free from adhesions and compressed against the vertebral column and the mediastinum; in 13 cases the organ was compressed from below upward; in 1 from above downward; in 4 from within outward; in 4 from behind forward; and in 4 from before backward. These variations depend on the adhesions which the lung happens to contract. Perhaps a point a little external to the perpendicular, passing through the angle of the scapula, is preferable for puncture, as I have known the lung to be adherent to the posterior wall of the chest near the mediastinum when the portion farther removed, say two inches from the median line, was separated by interposed liquid.

Sometimes the liquid is collected in multilocular cavities formed by the connective tissue, and these frequently intercommunicate. Exceptionally in children, as in the adult cases observed by Mohr, when there has been a large and rapid liquid exudation or when the disease has been violent and of short duration adhesions do not occur.

On account of the great difference in the size of the pleural cavity at different ages during infancy and childhood, the amount of liquid which produces that degree of compression of the lung which materially impairs its function varies greatly. At the age of four months three ounces produce complete collapse of lung, so that it resembles a fleshy mass (carnification). The largest amount of liquid relatively to the size of the chest in any of the cases which I have observed was about one and a half pints in the left pleural cavity in an infant that died at the age of twenty-two months in September, 1867. The heart lay chiefly to the right of the median line, and the diaphragm was convex toward the abdominal cavity. The case occurred in the almshouse on Blackwell's Island, and might in all probability have been relieved had attention been directed to it sufficiently early.

Liquid in the left pleural cavity, when considerable, presses the heart toward the mediastinum, so that the apex beat, instead of being a little internal to the linea mammalis, approaches the sternum. As the heart is carried to the right, the beat is felt under the lower end of the sternum, and with still greater increase in the effusion the pulsation is detected by the finger to the right of the sternum. If the exudation be on the right side, the displacement of the heart toward the left is, for obvious reasons, less than the displacement toward the right in pleurisy of the left side. Much external pressure upon the heart embarrasses its movements and prevents proper filling of its cavities, while the action of the organ is accelerated so as to compensate. Therefore, the pulse is quick and feeble.

In one instance in my practice the lower extremities and the portion of the trunk below the thorax became œdematous from compression of the ascending vena cava, and writers allude to cases in which other vessels and ducts, as the thoracic, were compressed so as seriously to embarrass their functions. The patient with the œdema was a boy of about four years, with empyema of the left side.

In large effusion the mediastinum is pressed against the healthy lung so as to diminish its transverse diameter, and Traube has shown that the effect of this is to increase the length of the lung or its vertical measurement. Consequently, as the lung on the healthy side extends lower than in the normal state, the convexity of the diaphragm on this side is diminished, as well as on the affected side, where it is depressed by the effusion.

The pleura in protracted cases of empyema becomes much infiltrated, and from the growth of connective tissue which blends with it is thickened, sometimes to the extent of one or two lines. A few months since, in removing the lungs from the body of a young infant that perished of empyema in the New York Foundling Asylum, a portion of the costal pleura, two or three inches in diameter, being adherent to the lungs, was detached from the ribs. It had a thickness of fully two lines and its free surface was rough.

Occasionally the inflammation extends from the pleura to the pericardium, producing general pericarditis. I recall to mind 4 cases with this complication in which the diagnosis was verified by post-mortem examinations. All had empyema, 3 on the left, and 1 on the right side. Pericarditis, always a grave disease, is almost necessarily fatal when thus occurring as a complication of empyema. More rarely the inflammation extends from the pleura to the peritoneum. One such case occurred in my practice, the child dying of empyema on the right side, and at the autopsy we found the lesions of a localized diaphragmatic peritonitis of the right side, with a fibrinous exudation of small extent on the convex surface of the liver directly opposite to that on the diaphragm. We are indebted to Von Recklinghausen for knowledge of the mode in which inflammation is propagated from the pleura to the peritoneum, and the same explanation probably applies to its propagation to the pericardium. In the serous covering of the diaphragm, pleural and peritoneal, minute stomata have been discovered which pertain to the lymphatic system. They open upon the surface of the diaphragm, and underneath in the substance of the diaphragm connect with lacunæ or interspaces from which the minute lymphatic vessels originate. These stomata and lymphatic spaces, pervious in their normal state, are usually clogged, as has been stated above, by inflammatory products when the serous membrane is inflamed. Occasionally the inflammation traverses these lymphatic channels from one surface to the other, from the pleura to the peritoneum, thus causing by extension a circumscribed peritonitis.

The changes which the inflammatory products undergo are the following: With the abatement of the inflammation the liquid portion begins to be absorbed, though absorption is much more tardy than in non-inflammatory effusions, since the absorbents are to a great extent covered and clogged by fibrin and pus. The serum is first absorbed, and the flocculi of fibrin sink into depending portions of the cavity or become attached to the fibrinous layers or the granulations upon the pleural surface. The pus-cells and the fibrin, whether in flocculi or layers, begin to undergo retrogressive change. They become granular from fatty degeneration, liquefy, and are absorbed. Sometimes portions of these degenerated products which are not absorbed form inert caseous masses in recesses of the cavity or between the bands of connective tissue, where they remain unchanged for years. With few exceptions, those who recover from an attack of pleurisy experience no subsequent ill-effect, though the bands and patches of connective tissue are permanent.

Pus always possesses irritating properties. Decomposed and putrid pus (ichor) is very irritating. Empyemic pus, therefore, like pus in other situations, now and then produces ulceration or necrosis of the pleural surface by which it is confined, and in consequence of its destructive action it sometimes establishes an outlet by which it escapes, with relief of the patient and cure of the disease. The chest-wall is thinnest anteriorly in the inframammary region, and at this point the pus, when it makes its way through the thoracic wall, usually points and discharges. The fistulous opening thus produced continues many months, until the pleural cavity is gradually obliterated by the adhesions and the patient recovers.

By a similar destructive process in the pulmonary pleura pus occasionally escapes into the bronchioles and is expectorated. This mode of cure appears to be common in children, for my attention has not infrequently been called to the fact that children, during the progressive but slow convalescence from empyema, expectorated large quantities of muco-pus, although in some of the cases pus had been removed by the aspirator or trocar. Fräntzel makes the remark—which is fully sustained by clinical experience in this country—that although an opening is made in the lung by the necrotic or ulcerative process, so that pus escapes into the bronchioles, air does not pass from them into the pleural cavity. Pyopneumothorax is very rare in the empyema of children, except as air is admitted in the operation of thoracentesis.

As the liquid is absorbed the compressed lung ordinarily expands in proportion to the absorption, so that more and more air enters its alveoli. But frequently, in cases of long duration, the absorption proceeds faster than the expansion, so that the ribs on the affected side sink below their normal level. As a consequence, the intercostal spaces are narrowed, the shoulder is depressed, and the dorsal portion of the spinal column bends to accommodate the ribs, so as to be concave toward the affected side. It is very rarely that the deformity thus produced is permanent. Though the newly-formed bands and patches of connective tissue may so bind the lung that its return to the normal state is tardy, yet with few exceptions the alveoli one after another open to admit air, and when full inflation is attained the symmetry of the chest is restored. But there are rare cases in which the newly-formed connective tissue is firm and unyielding almost as cartilage, and lime salts are sometimes deposited in it, forming a calcareous *plaque* which invests the lung like a cuirass. An unexpanded lung with such a covering obviously can never afterward be fully inflated. I can recall to mind, however, only one case of permanent complete collapse or carnification of lung resulting from pleurisy. The inflammation, which was treated by the late Dr. Cammann, occurred in childhood, and several years afterward, when the patient reached womanhood, although the general health was good, there were physical signs of an unaërated lung and the consequent deformity (depressed shoulder and ribs and bent spinal column). Pleurisy with its granulations and retrogressive products affords one of the conditions in which tubercles are developed, so that we sometimes find at the post-mortem examination of cases which have been protracted, "miliary tubercles in the pleura, while chronic phthisis and general tuberculosis are absent" (Delafield).

From the intimate relation of the heart to the lungs this organ obviously suffers severely in every large pleuritic exudation. Total compression of a lung arrests one-half of the circulation through the pulmonary artery, except as the increased flow in the opposite lung serves for compensation. Hence in cases of large effusion which end fatally we commonly find the pulmonary artery and the right cavities of the heart distended with blood and clots, while the left cavities, having received a diminished quantity of blood, are probably empty.

SYMPTOMS.—As has been stated above, pleurisy in children is sometimes latent or attended by symptoms so mild as to attract little attention even when there has been general inflammation of the pleural surface with much effusion. Both primary and secondary pleurisy may present this form, latency being more frequent the younger the patient. In feeble, cachectic children, with blood thin and impoverished, pleuritic symptoms, as pain, dyspnœa, and fever, are less pronounced than in the robust, and hence latency is more common in the tenement-house population of the cities and in institutions than in the better walks of life. The following is a not infrequent example of latency: A feeble infant, aged five months and twenty-eight days, died suddenly in the Nursery and Child's Hospital in December, 1870. The attention of the resident physician had not been called to it, as it was not supposed to be sick, except that it was ill-nourished and its general condition bad. The nurse who had charge of the ward stated that it presented no symptom of acute disease, unless a slight cough during the three or four days preceding its death. Percussion over the right side of the chest of the corpse gave a flat resonance, and at the autopsy the right lung was found compressed, nearly or quite destitute of air, and covered by a loose fibrinous layer three-fourths of an inch thick in places, and a moderate serous exudation.

Ordinarily, acute idiopathic pleurisy in children begins quite abruptly, and with symptoms which attract attention from the first. Probably in most instances it is preceded by rigors or a chilly sensation, but this usually escapes notice, if it be present, in patients under the age of five or six years. Fever, fretfulness, and a physiognomy indicative of pain are the common initial symptoms. If the patient be an infant, the fretfulness closely resembles that produced by colic, for which I have on several occasions known it to be mistaken by the attending physician.

The symptoms of pleurisy are twofold—namely, the constitutional, or such as are common to all inflammations, and the local, or those referable to the chest. Various observers have noted the position in which patients lie in bed as indicating the seat of the inflammation. It has been stated that adults, in the commencement of pleurisy, ordinarily obtain most relief with a decubitus on the sound side, but when effusion has occurred they lie on the affected side, unless there be marked dyspnœa, which is most relieved by a semi-erect position, which allows greater descent of the diaphragm. I have not noticed that children with pleurisy prefer any fixed or uniform position, except there be marked dyspnœa, which may prompt them to elevate the shoulders. The patient in the acute stage is commonly quiet when he lies in the position which he selects, and if disturbed from it becomes more fretful, his cough more frequent, and his suffering apparently increased.

In ordinary cases the temperature rises on the first day to 102° or 103°. If it be more elevated than this there is usually a complication. The temperature begins to abate when the exudation has occurred. In suppurative pleurisy the fever is more protracted, often continuing for weeks or months, presenting, after the acute stage has passed, the characters of hectic fever, with morning abatement and evening recrudescence. In weakly and anæmic children, even when the pleurisy is pretty severe and most of the usual symptoms are present, the temperature may be but slightly elevated. Thus in one of the institutions with which I am connected, in a young infant whose fretfulness was during the first twenty-four hours ascribed to colic the axillary temperature during the first three days never rose above 100°.

The pulse in the acute stage is usually between 100 and 130 per minute, but in young children who are restless it is often more frequent than this during the first week. It is accelerated as long as the temperature is elevated, but in sero-fibrinous pleuritis after exudation has occurred its frequency diminishes unless the heart be compressed. Compression and imperfect or partial filling of the cavities of the heart produce a feeble and rapid pulse. In empyema the pulse is accelerated as long as pus is confined in the pleural cavity, unless its quantity be small.

Headache, usually frontal, is frequent during the febrile stage. Convulsions, which occasionally occur in the beginning of pneumonia, are rare. Pain in the chest on the affected side is common, and is therefore a valuable diagnostic symptom, but it is often so slight as to be overlooked in infants and feeble children. It is increased by movements of the chest-walls, as in full inspiration, by coughing, and when pressure is made by the fingers in the examination. Its common seat is between the fifth and eighth ribs, external to the linea mammalis, but there are many cases in which the pain is referred to some other part, as the infraclavicular, mammary, inframammary, or even the scapular or infrascapular, region. Rarely, it is referred to the epigastric or umbilical region, or even, it is said, to some point upon the sound side of the thorax. This location of the pain at a point distant from the seat of the inflammation is attributable to the anastomosis of the intercostal nerves with those of the opposite side of the chest or with those which ramify in the abdominal walls.

The pain of pleurisy, as it ordinarily occurs, has received different explanations. It has been attributed to tension of the pleura, to friction of the pleural surfaces on each other, and to extension of the inflammation to the neurilemma of the minute nervous branches of the pleura. All these causes apparently act in producing it, but the persistent pain in the first days of pleurisy, though increased by motion, is probably due in great part to that last mentioned. Pleuritic pain is sharp or stitch-like. It begins to abate in a few days, and in a large proportion of cases ceases by the fifth or sixth day, or is no longer noticed except in coughing or during sudden movement of the chest.

The respiration is accelerated, as in all febrile diseases, but it is more rapid than in inflammatory ailments which do not involve the thoracic organs, on account of the pain experienced on full inspiration. The patient instinctively avoids full inflation of the lungs, and the breathing is consequently rapid, to compensate for incompleteness of the inspiratory act.

In ordinary attacks of pleurisy painful and hurried respiration is of short duration. It becomes easier and more natural toward the close of the first week. In subacute and chronic cases the rhythm and frequency of respiration differ but little from the normal.

A cough, whatever the form of pleurisy, is one of the earliest symptoms. It is short, frequent, and dry, and in the most favorable cases begins to diminish in the second week. A loose cough is due to accompanying bronchitis or broncho-pneumonia, or, at a late stage of the disease, to escape of pus from the pleural cavity into the bronchial tubes.

Little need be said in regard to symptoms referable to the digestive apparatus. Vomiting is common on the first and second days. Thirst, loss of appetite, and consequent loss of flesh and strength, are uniformly present. In empyema, which from its nature is protracted, nutrition is always greatly impaired. The surface presents an anæmic appearance, the flesh is soft and flabby, and the emaciation is progressive till the pus is evacuated.

PHYSICAL SIGNS.—In children above the age of three or four years, the physical signs differ but little from those in adult cases, but under this age there are certain differences which the practitioner should know. We may, in the commencement of the attack, notice diminution in the movement of the chest-walls on the affected side, since the patient instinctively endeavors to repress respiration on that side in order to lessen the pain. In severe cases the epigastrium and hypochondria are sometimes depressed during inspiration (the so-called abdominal respiration), but this sign is less common and less marked than in severe bronchitis, and when present it may be largely due to accompanying bronchitis. After effusion has occurred and the pain has abated or is slight, the respiration is less accelerated than at first, and it may be nearly or quite normal.

Inequality of the two sides produced by the liquid is more common in children of an advanced age than in those under the age of three or four years. In infants, even when there is a large liquid exudation, the bulging is often so slight that it is scarcely appreciable either by sight or measurement, and in not a few there is no apparent difference in the circumference of the healthy and affected sides. I have made measurements in infantile pleurisy during the stage of effusion, and been unable to convince myself that there was any difference, although other signs indicated the presence of an effusion which filled at least one-half the pleural cavity. I explain this fact in this way: The lungs of an infant, especially of one reduced by sickness, are very liable to a state of semi-collapse or partial inflation in their whole extent and of complete collapse of their thin borders, as of the tongue-like process of the left upper lobe, which lies over the pericardium, and of the margins of the lower lobes, which lie in the angle made by the thorax or diaphragm. This occurs in the weakly infant even when there is no obstruction to the entrance of air, and the liability to it is greatly increased by external pressure applied to the lung, as from a pleuritic effusion, so that the lung recedes, becomes compressed, and unaërated before the ribs yield to the pressure. If the exudation cease as soon as the lung is collapsed, there is little or no outward displacement of the ribs and the intercostal spaces are not elevated. It is obviously very important to know this difference between infantile and adult cases, as it has a bearing upon the diagnosis between pleurisy with effusion and pneumonia.

Palpation.—In adults and in children with strong voices, if the lung deprived of air, either by compression or an exudation within its alveoli, lie against the chest-wall, speaking or moaning produces a vibratory sensation which is communicated to the hand placed upon the chest. The fremitus is feeble or not appreciable when the voice is feeble. Therefore, in infants whose vocal cords are small, and particularly in infants reduced by sickness, this sign is ordinarily absent or so slight that it is detected with difficulty, while in older and robust children it is distinctly perceived. If the condition be otherwise favorable for the production of fremitus, but the lung be pressed away from the ribs by an intervening liquid, no vibration is felt when the patient speaks or cries. But if, in the same case, the fingers be removed to the suprascapular, axillary, infraclavicular, or mammary region, where the compressed lung comes in contact with the walls of the chest, fremitus may be perceived. Palpation also enables us to ascertain the point of apex-beat of the heart, variation of which from the normal size being one of the most conclusive proofs of a pleuritic effusion.

Percussion.—In the first hours of pleurisy there is either no perceptible change in the percussion sound, or the resonance is slightly diminished from the fact that inspiration on the affected side is resisted by the patient and the lung is only partially inflated. When exudation occurs, if there be a thin layer of liquid over the lung the percussion sound is tympanitic. It has, therefore, this quality at an early stage in the inframammary, mammary, and perhaps infrascapular regions when the amount of liquid is small, and at a later stage, when the quantity of liquid is greater, the percussion sound over the lower part of the chest is dull, while that over the central or upper part is tympanitic. Entire filling of the pleural cavity with liquid, and total exclusion of air from the lung, give rise to a dull or flat percussion sound over every part from the apex to the base. It may be stated as a rule in the pleurisy of children that at a certain stage of the effusion percussion produces a sound which is either decidedly tympanitic or which partakes of the tympanitic character. Skoda attributed the occurrence of tympanism to the fact that a lung still aërated vibrates better if surrounded by a thin layer of liquid, and consequently gives better resonance than when it lies against the chest-walls.

When the exudation is so great that the lung is totally compressed and removed to a distance from the chest-walls, the finger in percussing experiences a sensation of solidity or resistance and there is no longer any vibration of the ribs. Consequently, the percussion sound is dull or flat, as over any solid body, differing from that in pneumonia, in which there is still some vibration of the chest-walls and the dulness is not absolute. In pleurisy, therefore, there is, according to the amount of exudation, either nearly the normal percussion sound, as at the beginning of the attack and in any stage of plastic pleurisy (pleurésie séche), or a zone of dull sound below and another of tympanitic sound above, or a zone of normal resonance above and one of dull resonance at the base, with an intervening one of tympanism; or, finally, there is absolute dulness from the clavicle to the base of the chest.

It very rarely happens in the child that the level of the fluid changes by changing the position, on account of the adhesions, so that this sign, described in the books as one of great importance in diagnosis, affords very little assistance to diagnosis in children.

Auscultation.—In the beginning of pleurisy auscultation affords but slight information, except that the practised ear may detect a little diminution in the fulness of the respiratory act in the lung whose pleura is inflamed, and perhaps a slightly exaggerated respiration in the other lung. But after twelve or fifteen hours, when exudation begins to occur upon the pleural surface, we may hear the dry friction sound, which can be imitated by pushing the finger strongly across the dry palm of the hand. It is only heard in occasional cases, since the physician may not make his visit at the proper time for hearing it or he does not apply the ear over the proper place. Fräntzel says: "We shall scarcely ever fail to find the friction sound in recent pleuritis if we look for it early and diligently in some circumscribed spot." I do not think that this remark, however true it may be of adult cases, is entirely correct as regards children, for it is only in exceptional instances that it can be heard in them. It occurs both during inspiration and expiration, and it does not disappear after coughing. Being produced upon the surface of the lung, it seems near the ear of the auscultator. Perhaps it is not observed during several consecutive respirations, and then a deeper inspiration causes the pleural surfaces to glide upon each other, and it is detected. The friction sound as sometimes heard is well described by the term "scraping," and in other cases by the term "creaking," as was noticed by Hippocrates, who compared it to the creaking of leather.

In some patients it is heard for a brief period, and does not recur, and it may be detected only during strong and deep respiration or in coughing. It disappears entirely when the accumulation of liquid prevents contact of the surfaces. After absorption of the liquid the friction sound may reappear, and in certain patients it is heard only at this time—to wit, in the third stage.

An interesting and common sound heard on inspiration is the so-called *crepitant râle of pleurisy*, produced in the superficial alveoli. The remarks made by Trousseau upon it have been already given. As stated above, the inflammation extends from the pleura to the pulmonary vesicles which lie directly underneath, and as soon as exudation occurs within them the anatomical conditions are present in which the crepitant râle is produced, as in the ordinary form of pneumonia. This râle may obviously be heard before any effusion takes place upon the free surface of the pleura, and it continues until the alveoli are so compressed by the plueritic exudation that they no longer admit air.

The exudation in the pleural cavity changes the character of the respiratory sound. A thin layer of liquid over the lung causes diminution in the force of the vesicular murmur, and soon an expiratory as well as an inspiratory sound begins to be heard. This modified vesicular murmur is weak, and more distant from the ear than the respiratory sound of health. When the exudation is sufficient to close the alveoli, while the air still traverses the medium-sized bronchial tubes, we notice a tubular or bronchial *bruit*. If the small and medium-sized tubes are compressed while the air enters the large tubes, the respiratory bruit may be amphoric. Total absence of respiratory sound results from complete collapse of the alveoli and consequent exclusion of air from them, and arrest of the movements of the air in the tubes of the affected side. Jaccoud says: "Regarded as a sign of the quantity of the effusion, the modifications of the respiratory *bruit* and of the respiration may then be arranged in an increasing series, as follows: diminution of the vesicular murmur; feeble respiration (*souffle doux*); no sound and feeble respiration; bronchial respiration; no sound and bronchial respiration; no sound and cavernous respiration; general absence of sound (*silence général*). The replacement of an inferior term of the series by a superior term implies an augmentation in the quantity of liquid, and in general the passage of a superior term to an inferior term denotes a diminution of the effusion." But this statement relating to the effect upon the auscultatory sounds of the increase and decrease of the liquid must be modified as regards patients under the age of five years. In such patients it is rare, however great the effusion, that respiration is not heard when the ear is placed over the liquid. This is due to the small size of the pleural cavity, and the consequent ready transmission of sound from the centre of the thorax to its periphery. According to the amount of exudation and the degree of compression, the respiratory sound is a faint and distant vesicular, or broncho-vesicular, or bronchial murmur, and its character is found to vary from one to the other of these sounds as we apply the ear over different parts of the chest.

When the inflammation is active and the exudation occurs rapidly, bronchial respiration may be heard as early as the second or third day, or even by the close of the first day, in the infrascapular region. If, on the other hand, the inflammation be chiefly plastic or the exudation of liquid be slow and its quantity small, the respiratory murmur may be vesicular, though faint and distant, during the whole course of the attack. Sometimes when the murmur is vesicular in the greater part of the lung, broncho-vesicular or bronchial respiration is heard over a limited area, where the effusion happens to be sufficient to produce requisite compression of the lung.

The voice of the patient when auscultated over the affected side has a character which corresponds with and varies according to the respiratory murmur. Vocal resonance is feeble or absent if the respiratory murmur be vesicular. If it be bronchial, the auscultated voice is more distinct, having the character known as bronchophony, or when there is a moderate quantity of liquid over the lung, so that this organ vibrates, it may have that modification of bronchophony known as ægophony. Occasionally we can hear the voice as a confused and distant sound when the quantity of liquid is so great that respiration is inaudible. The signs derived from the auscultated voice are not, as is well known, pathognomonic of liquid effusion. Bronchophony is more common and distinct in pneumonic or tubercular solidification of lung than in pleurisy, and even ægophony may be produced without the presence of a liquid by "pleural membranes realizing certain physical conditions" (Jaccoud). But since the auscultated voice is weaker in children than in adults, we often do not hear it in infants and ill-conditioned children, even when the anatomical conditions as regard the lungs and pleural cavity are favorable for its transmission.

In children, as in adults, bronchial râles are common in pleurisy, dry or moist; coarse when produced in the larger tubes, or fine when occurring in the finer tubes.

DIAGNOSIS.—Ordinarily, a careful observance of the history, symptoms, and physical signs enable the physician to make a positive diagnosis. Obscure or doubtful cases occur chiefly in infancy. Circumscribed pleurisy or pleurisy attended with little or no liquid exudation is obviously likely to be overlooked and its symptoms mistaken for those of another disease.

Pleurisy before the stage of exudation may be mistaken for pneumonia, since the prominent symptoms in the commencement of the two diseases are similar. But in pleurisy there are commonly greater acceleration of pulse and respiration, greater suffering as evinced by the features, greater tenderness on percussion or on pressing the chest-wall, and a more decided expiratory moan, while the patient probably endeavors to repress respiration on the affected side, so that inflation of the lungs is partial and shallow. It will aid in the diagnosis to recollect that in children under the age of five years acute pneumonia is in most instances catarrhal, and not croupous, and is preceded and accompanied by severe bronchitis, being due to downward extension of the inflammation from the bronchial tubes. It therefore does not begin with the abruptness of pleurisy.

Pleurisy with effusion may be mistaken for pneumonia in the stage of solidification, for hydrothorax, or, on the left side, for pericardial effusion, or *vice versâ*. But the percussion sound over a pleuritic exudation is either tympanitic or flat, while over a lung solidified by inflammation it has some resonance, though dull. There is also a sensation of greater resistance and solidity in percussing over a pleuritic exudation than over an inflamed lung. Moreover, the respiratory murmur, whether vesicular, broncho-vesicular, or bronchial, is more distant and less distinct to the ear of the auscultator when applied over a liquid than over a solidified lung.

A pleuritic exudation, unless slight, also changes the apex-beat of the heart, pressing it toward the median line in left pleurisy, and away from the median line in right pleurisy, as has been stated above—a change not observed in pneumonia. Bulging of the intercostal spaces, expansion of the chest-walls, change in height of the fluid by change in the position of the child—important signs in the diagnosis of adult pleurisy—are, as we have seen, commonly absent in young children, even when there is abundant liquid effusion, but they are sometimes observed in children of a more advanced age. Bronchophony and vocal fremitus, signs of pneumonic solidification, are absent or so feeble in the pneumonia of young children that their absence cannot be regarded as indicative of the presence of pleuritic effusion, except in children over the age of four or five years. Moreover, these signs, when present, do not necessarily indicate pneumonia, for if in pleuritic effusion the ear or hand be placed over a part of the chest where adhesions have united the lung to the ribs, and the child be of such an age that the vocal cords have sufficient vibration, both bronchophony and the fremitus may be perceived. The absence or presence, therefore, of vocal fremitus and bronchophony affords only limited assistance in the differential diagnosis of pleurisy and pneumonia in young children. In those of an advanced age, whose vocal cords have greater vibration, it aids in the discrimination of doubtful cases, especially if the examination be made in the infrascapular region, which corresponds with the location of the liquid, if any be present.

A pleuritic effusion is distinguished from hydrothorax by the fact that the latter is usually bilateral and of slow increase, without symptoms referable to the chest, except when there is considerable effusion, which causes more or less dyspnœa. Pleurisy, unlike hydrothorax, causes fever and other constitutional symptoms, and also a cough, pain in the chest, and early embarrassment of respiration. Moreover, hydrothorax seldom occurs, except from cardiac or renal disease or scarlet fever.

A greatly distended pericardial sac simulates in some degree a pleuritic effusion on the left side, but the absence of symptoms which pertain to pleurisy, as the cough, stitch-like pain in the chest, the localization or greater distinctness of the dull sound on percussion in the cardiac region, absence or feebleness of the apex-beat, and indistinctness or distance of the heart-sounds, will preserve the observant physician from error of diagnosis.

PROGNOSIS.—In mild cases attended with little exudation the inflammation soon begins to abate, and by the close of the second week the symptoms have nearly disappeared. In plastic and sero-fibrinous pleurisies recovery may be confidently expected, unless there be some grave complication, or perchance syncope should occur from large and rapid effusion. A large effusion, whatever its character, especially if located on the left side, often causes such a twist in the great vessels within the thorax as seriously to retard the circulation of blood and endanger life. In effusions of the left side the heart is often carried so far toward the right that the ascending vena cava, where it emerges from the central tendon of the diaphragm, is bent at an angle so as seriously to obstruct the return of blood from the lower half of the body, and consequently a reduced quantity of blood reaches the right cavities and the pulmonary artery. The result is a diminished flow of blood in the systemic circulation, with anæmia of important organs, as the brain. The great arteries connected with the heart are also more or less bent in cases attended by displacement of this organ. In effusions on the right side the right auricle and ventricle sometimes do not expand to the normal extent during the diastole, on account of the pressure of the liquid, and the result is similar to that in effusions on the left side as regards obstructed circulation and anæmia of important organs. Therefore, patients with large pleuritic effusions, whether left or right, are liable to sudden fainting and even to fatal syncope. Fortunately, with our present improved methods of thoracentesis children need not perish in this way if the operation be resorted to at the proper moment. There is another danger. When, in consequence of the exudation, the lung is so compressed that its function is nearly or quite lost, the sound lung obviously receives an augmented supply of blood. It is therefore very liable to sudden congestions and transudation of serum (œdema). If this occur, the dyspnœa is augmented and the condition is one of utmost peril. Death may result from this state.

The prognosis obviously varies according to the cause of the inflammation and the quantity and nature of the exudation. Idiopathic pleurisies do better, as a rule, than those which occur as a complication or sequel of some other disease. Absorption is more rapid in the beginning of convalescence, when the fluid is thin, than at a later period, when it has greater consistence. Fibrin, whether flocculent or laminated, is necessarily slowly absorbed, first undergoing fatty degeneration and liquefaction. Empyema, if not relieved by operative measures, continues many months; even after pus is let out convalescence is slow. In the very considerable number of empyemic cases which have from time to time been brought to the class of children's diseases in the Bureau for the Relief of the Out-door Poor the histories commonly showed that the disease had continued from three to six months, with progressive loss of flesh and strength. Nevertheless, after proper evacuation of the pus and the establishment of a fistulous opening the majority have gradually recovered, death in the unfavorable cases being commonly due to extreme prostration with perhaps fatal organic changes, as amyloid degeneration and tuberculosis.

Secondary pleurisy occurring in a reduced state of the system, as after scarlet fever, and pleurisy complicated by a grave disease, as pericarditis or pneumonia, are always dangerous to life.

It is the common belief that pleuritic effusions involve greater danger on the left than on the right side, from the fact that the former produces more immediate and direct pressure on the heart and causes a greater twist in the vessels, but Leichtenstern[1] states that in 52 cases of sudden death from pleuritic effusions, 31 were right and 20 left pleurisies. The walls of the right cavities of the heart, upon which the liquid in the right pleural cavity directly presses, are thinner, and therefore more yielding, than the walls of the left cavities. The records of the cases collected by Leichtenstern show that sudden death sometimes results from extensive and far-reaching thrombi in the right cavities of the heart and in the superior vena cava, or from emboli detached from the thrombi and intercepted in the pulmonary artery. In grave cases attended by large effusion sudden death sometimes occurs after some exertion on the part of the patient, as after vomiting, severe coughing, or hurried rising to the erect position or lifting a heavy weight. It is believed that under such circumstances there is a retarded flow of blood through the lungs and into the left cavities of the heart and the aorta, so that sudden and fatal anæmia of the brain is produced.

As already stated, death may occur in protracted cases from amyloid degeneration of important organs, as the kidneys and liver. This can sometimes be detected by enlargement of liver and spleen and the occurrence of albuminuria.

It is evident that the prognosis varies greatly according to the degree of dyscrasia. In profound blood-poisoning, whether scarlatinous, uræmic, or septicæmic, pleurisy is always grave. Septic pleurisy, which occurs for the most part in new-born infants during epidemics of puerperal fever, is especially so. When it has continued a few hours the pinched features and rapid sinking show that we have to deal with something more than an ordinary attack.[2]

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[1] *Deutsches Archiv für klin. Med.*, Band iv.

[2] The following case, which occurred in my practice during the epidemic of puerperal fever in 1881, may be adduced as an example: Mrs. D——, a primipara, was delivered by the forceps, after a tedious labor, at 9 P. M., April 6th. On the following morning her temperature, without the occurrence of a chill, had risen to 105½°, and her pulse varied between 125 and 134. She was in a critical state for several days with a temperature varying between 103° and 105½°, and without any local symptoms either of metritis or cellulitis, but finally recovered. The baby, healthy and vigorous at birth, had been allowed to obtain what nutriment it could from the breast, but the nurse remarked that she "never saw a child sleep so much," and I gave very little attention to it, as my time was devoted wholly to the mother. On the 10th, when four days old, its sleepiness ceased, and it became constantly fretful, as from colic, and it refused to draw the nipple. Early in the morning of the 11th I was summoned to it, and was astonished at its altered appearance, its shrunken features, and its evidently dying state. Percussion upon the right side gave a flat resonance from the clavicle to the diaphragm, and there was some meteorism in the abdomen. The thermometer introduced into the rectum showed no elevation of temperature, and no unusual heat of surface or cough had been noticed by the nurse. By active stimulation the infant lived till the middle of the afternoon. The autopsy revealed a sero-fibrinous exudation filling the right pleural cavity, producing complete carnification of the lung, so that it resembled that of the fœtal state, and soft patches or flakes of fibrin upon the lungs. By an oversight the peritoneum was not examined. Cases like this, of pleuritis in the new-born, produced, it is thought, by the wandering micrococci of the septic state, occur chiefly during epidemics of childbed fever. Some years ago I saw a new-born infant in one of the institutions, whose mother had puerperal fever, die in a similar manner, and the autopsy showed that the cause was peritonitis. The following example from Trousseau's clinical lecture on erysipelas of new-born infants will aid in understanding such cases. Speaking of Dr. P. Lorain, he says: "During the epidemic at the Maternité, where this able and laborious observer was resident pupil, he collected the information of which the following is a summary: Of 106 stillborn infants, 10 were found to have died from peritonitis, and 3 of the mothers of these 10 infants were carried off by puerperal fever after delivery. Of 193 infants born alive, 50 died of the very same affections which proved fatal to the lying-in women. The most frequent causes of death were peritonitis, numerous abscesses, purulent infection, phlegmonous

Pleurisy is also very severe, and ordinarily fatal, when it is caused by the entrance of some pathological product into the pleural cavity, as pus or decaying lung-substance.

TREATMENT.—It will be proper, in considering the treatment, to describe that which is appropriate for each of the three stages into which writers have for convenience divided pleurisy: First, the stage preceding effusion; secondly, that of effusion; and thirdly, that of absorption and convalescence. In the beginning of the inflammation appropriate measures should be promptly employed for the purpose of reducing the inflammation and preventing or diminishing, so far as possible, the exudation that soon follows. The abstraction of blood is now properly discarded in the treatment of most inflammations of infancy and childhood, but in certain cases of pleurisy occurring in robust children over the age of four or five, or even three years, the early and judicious employment of one or two leeches diminishes the pain and temperature, and apparently also, to a certain extent, the inflammation. But it may be stated as a rule that the loss of blood is not only not required, but is injurious, in all secondary pleurisies, and in the primary form after exudation has occurred. It is injurious in all forms of pleurisy in pallid and cachectic children, and therefore in a large proportion of the cases occurring in the tenement-houses and institutions of the cities. The flow of blood from the bites if leeches are employed should ordinarily be arrested after two or three hours, but if slight it may continue longer in vigorous children of eight or ten years.

At the first visit of the physician an emollient and slightly irritating poultice should be ordered, enveloping the entire chest, to be constantly worn, except as it is temporarily removed during the application of the leech and the subsequent flow of blood. The poultice should be so mildly irritating that it causes constant redness of the skin without pain, and it should not be removed except when a fresh poultice is prepared to replace it. Thus employed, it produces constant dilation of the capillaries of the skin, and by the fluxion caused diminishes the engorgement of the capillaries of the costal pleura. A poultice of common mustard, with flaxseed in powder, one part to sixteen, between two pieces of muslin, and so wet that it moistens the hand in holding it, produces this effect. Applied morning and evening, it can be constantly worn without complaint of pain produced by its irritating action. For infants under the age of eight months I prefer the use of plain flaxseed, with camphorated oil smeared upon its under surface. The oil may be applied several times daily, while the morning and evening application of the poultice is sufficient. Spongiopilin or compresses of flannel wrung out of hot water and covered with oil-silk meet the indication, and possess the advantage of being lighter and cleaner and more readily applied than the poultice. Redness may be produced by applying under the spongiopilin a single thickness of muslin soaked with camphorated oil, or for children of a more advanced age with camphorated oil and one-fourth part of turpentine.

Vesication, formerly much employed, has properly nearly fallen into disuse in the treatment of the pleurisy of children. While it is liable to increase the suffering, it has apparently no tendency to diminish the inflam-

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swellings, erysipelas, gangrene of the limbs, putrid infection, or some other remarkable septic condition." . . . . "Mother and child then are subject to the same morbific influence." Farther on Trousseau says of the infant affected by this puerperal poison: "It will cry incessantly from pain. A state of restlessness will be succeeded by collapse, which will close the scene on the fifth, sixth, or seventh day. On examining the body after death pus will be found in the cellular tissue, sometimes *suppurative pleurisy*, more frequently phlebitis of the umbilical vein or of the vena porta, or peritonitis." An interesting incidental fact shown by these statistics is that the cause of this puerperal disease of the new-born is sometimes operative in the fœtal state.

mation in whichever stage employed, and there is no certainty that it stimulates the absorbents and expedites the removal of the liquid, according to the old theory. A case is reported in the practice of one of the New York physicians in which a blister had been applied when the inflammation was still active, and at the autopsy the portion of the costal pleura which lay directly underneath the surface that had been vesicated was covered by a thicker fibrinous exudation than that upon the contiguous surface. The increased afflux of blood caused by the blister had, to appearance, extended to the costal pleura and increased the pleurisy. The application of cold bandages around the chest, which is recommended by some, seems to aggravate the cough in certain patients, and does not ordinarily give the relief of moist and warm applications.

Internal Remedies.—The indications are to employ such medicines as diminish the frequent action of the heart, and thus retard in a measure the flow of blood to the pleura, and such as diminish the pain and frequency of the cough, which by increasing the friction of the pleural surfaces tends to increase the inflammation. For robust children over the age of three years in the first stage of primary pleurisy the tincture of aconite may be prescribed, half a drop for a patient of three years, and one drop for one of six years, every third hour for two or three days, or until the required effect be produced upon the pulse, when it should be discontinued. It is, as a rule, too depressing for younger patients. Digitalis is a better and safer remedy for children under the age of three years for all secondary pleurisies and for all cachectic cases. Benefit results from continuing the use of digitalis in the stage of exudation, when aconite would be inadmissible. A child of two years can take two drops of the officinal tincture, and one of five years four drops, every two or three hours.

Antipyrine is an effectual antipyretic. One or two doses reduce temperature two or three degrees. It therefore promises to be a useful remedy in the first stage of pleuritis as well as in other acute diseases, when the temperature is so high as to involve danger. It is not a tonic, and it seems to impair the digestive function. It is therefore most useful in those diseases which are not attended by any marked prostration, but in which the fever, from its intensity, exhausts the strength. If, therefore, in the commencement of pleurisy the temperature rises above 103°, it may properly be prescribed in doses of four grains to a child of five years, and be repeated, if necessary, in three hours. It is soluble in water, and it may be employed as an enema if the stomach be irritable. Phenacetin or antifebrin may be employed as a substitute for antipyrine.

The use of quinia is suggested, since it is an antipyretic and tonic, but in my practice it has been much less useful in pleurisy than in pneumonia. This agent, in whatever form given, does not appear to exert any notable controlling effect either on the fever or gravity of pleurisy. Nevertheless, I have often employed it, especially in secondary pleurisies, with or without digitalis, and it probably does some good as a tonic. The salts of quinia, as ordinarily given in solution to young children, are frequently vomited. When vomited, a soluble salt, as the bisulphate, may be given as a suppository, or Squibb's oleate of quinia may be employed by inunction. I should, however, add that, though I have used inunctions of the oleate in pleurisy during the last year, ten grains of the alkaloid at a time, I have not seen any marked beneficial effect. To meet the second indication in the treatment of the first stage—namely, to relieve the pain and restlessness and to diminish the cough, so that there is less friction of the pleural surfaces—our chief reliance must be on hyoscyamus or one of the opiate preparations. The following formulæ will be found useful:

℞. Tinct. opii deodorat., gtt. xx;
Tinct. digitalis, gtt. xl;
Syr. pruni virginiani, ℥j;
Aquæ, ℥jss. Misce.

Dose: One teaspoonful (one drachm) every three hours for an infant of eighteen months. The tincture of hyoscyamus may be employed in place of the opiate in double the dose.

For a child of three years:

℞. Tinct. ipecac. comp.
(Squibb's liquid Dover's powder),
Tinct. digitalis, *āā*. gtt. xxxij;
Syr. pruni virginiani, ℥ij. Misce.

Dose: One teaspoonful every two or three hours.

For a robust child of eight years with primary pleurisy:

℞. Morph. sulphat., gr. j;
Tinc. rad. aconit., gtt. xx;
Syr. pruni virginiani, ℥ijss. Misce.

Dose: One teaspoonful every three hours.

The diet in the first stage should consist of milk and farinaceous food, given liberally. The meat teas or the expressed juice of meat may be added, and in secondary pleurisies, as after scarlet fever, it is often proper to give a moderate amount of alcoholic stimulants from the first.

Second Stage.—Measures employed in the first stage have been designed to diminish the inflammation and relieve suffering. The duty of the physician in the treatment of the second stage is chiefly to aid in the removal of the inflammatory product, and prevent, so far as possible, its further formation. If this be sero-fibrinous and its quantity be small, so as to fill only the lower portion of the cavity, little aid may be needed from therapeutics; but a larger effusion, compressing the lung and displacing the heart, requires medicinal and often surgical measures. The recommendations of Niemeyer, that the patient's food contain little liquid and that his drinks be restricted as a means of increasing absorption from the pleural surface, is not applicable to young children, whose diet must of necessity be largely liquid, and that of infants chiefly milk.

Attempts to stimulate the absorbents by external treatment of the chest are of doubtful efficacy, whether by the application of small blisters, cantharidal collodion, the iodine ointment or tincture, or a stimulating liniment. The common practice of treating glandular swellings by iodine applications suggests their use for pleuritic effusions, and of the agents employed locally to hasten absorption they are probably the best, but they should not be used so often or in such quantity as to cause pain or restlessness from their irritating effect. The following ointment may be used:

℞. Potas. iodidi, ʒij;
Lanolin, ℥ij. Misce.

To be rubbed freely over the side of the chest which is the seat of the sero-fibrinous exudation three or four times daily.

It is an established principle in therapeutics that the removal of a serous liquid in either of the larger cavities of the body is hastened by such remedies as produce an abundant liquid secretion or transudation from any of the organs or surfaces. Hence in the treatment of pleuritic effusions those medicines which act on the skin, causing diaphoresis, upon the intestines, causing watery stools, and upon the kidneys, causing diuresis, are at once suggested as most likely to be efficacious. But sudorifics, though useful for dropsies having a renal origin, have not been much used of late years for the removal of exudations in the pleural cavity, experience having shown that they are inadequate for this purpose. Recently, however, the discovery of a very active agent of this class, jaborandi, has revived in a measure the sudorific treatment of the second stage, so that in the National Dispensatory of Stillé and Maisch this diaphoretic is one of the recommended remedies. But the heart, crippled in its action by the pressure of the liquid, badly tolerates agents of a depressing nature, and jaborandi, or its active principle pilocarpine, exerts a weakening effect on this organ. It therefore should be used with caution in this disease. It is probably best in most instances not to employ it, inasmuch as we possess other and efficient remedies.

The fact that sero-fibrinous exudations have been known to diminish rapidly during attacks of diarrhœa suggests the use of purgatives; but, although an open state of the bowels, as two or three daily stools, aids in absorption, free purgation is badly borne by young or feeble children, as it reduces the strength, and therefore is not to be recommended as a therapeutic measure. Moreover, there is not the need of employing severe or exhausting medicines for the removal of the liquid which existed in former times, since we are able to accomplish this quickly, easily, and safely by the excellent aspirating instruments now in common use.

Diuretics, on the other hand, are apparently more useful, while they are less exhausting, than sudorifics or cathartics. Digitalis, combined with the citrate or acetate of potassium, has stood the test of experience, and is now more widely used than any other agent of this class. Being both a diuretic and heart-tonic, it possesses properties which render it especially serviceable in the treatment of pleuritic effusions. The following is a useful prescription for a child of five years:

℞. Potassii acetatis, ʒij;
Infus. digitalis, ℥iij. Misce.

Give one teaspoonful every three hours.

It is a matter of observation that absorption occurs more rapidly, and a sero-fibrinous is less likely to become a purulent effusion, if the bodily condition be good. Hence tonics, especially the bitter vegetables, are sometimes useful, and a diuretic in combination with a tonic, as the acetate of potassium in decoction of cinchona, may often be prescribed with advantage.

Still, however judicious the treatment, hygienic and medicinal, many cases require surgical interference, and the number of such is larger in the city than in the country, and in tenement-houses than in the better walks of life, since the cachexia so common in city children increases the liability to purulent exudations.

Thoracentesis.—The indications for the operation are the following:

1st. Dyspnœa due to the presence of the liquid, whether it be sero-fibrinous, purulent, or hemorrhagic. Usually when dyspnœa occurs the pleural cavity is full, and if there be parenchymatous disease of either lung a moderate quantity of liquid may cause such embarrassment of respiration that thoracentesis is indicated.

2d. A flat percussion sound over the entire affected side, with displacement of the heart, even if there be no present dyspnœa, is also an indication for the operation, for dyspnœa may occur suddenly with other alarming symptoms between the visits of the physician. Moreover, experience has shown that absorption from a distended pleural cavity is very tardy, in consequence of compression of the absorbents, whereas if a portion of the liquid be removed absorption of the remainder is more rapid. The patient with full pleural cavity and lung totally compressed lies on the affected side, and is usually uncomfortable in any other position, and the withdrawal of a portion of the liquid—as, for example, one half—the operation being discontinued when the patient begins to cough or evince distress, produces no ill-effect and increases the comfort.

3d. A moderate effusion, without material decrease in quantity after some weeks of observation, also indicates the need of surgical interference, since long compression of a lung involves risks. There is danger that catarrhal ending in cheesy pneumonia and tubercles may occur in a lung whose function is long suspended; besides, the longer compression has existed the more tardy, difficult, and incomplete will be the inflation when the liquid is removed, on account of the altered state of the alveoli and the presence of fibrinous bands over the lung. Thus, in a case recently under observation only partial inflation of the lung occurred after letting out the liquid, so that the ribs and shoulder on the affected side are permanently depressed and unequivocal symptoms of tuberculosis are now present.

4th. If the inflammation extend to the pericardium, so as to cripple the heart's action, or if there be any serious pre-existing heart disease, the liquid, even in moderate quantity, may by pressure so embarrass and retard the heart's action that its cavities are not properly filled, so that passive congestion of certain organs and dangerous anæmia of others, especially of the brain, may result. Under such circumstances an early performance of thoracentesis is indicated.

5th. *Empyema.*—The presence of pus in the pleural cavity affords in itself, in a large proportion of cases, sufficient indication of the need of thoracentesis. In recent cases with only moderate constitutional disturbance and embarrassment of respiration, if we ascertain by the hypodermic syringe that the liquid is only slightly clouded by leucocytes, surgical interference may be postponed while the acute inflammation is treated. Thus, in case of an infant of two months thin pus was withdrawn on the fourth day of acute pleuritis, and, although thoracentesis was early performed, it appeared probable, from the subsequent course of the case, that it would have been as well had the operation been deferred. If spontaneous evacuations of pus have occurred through one of the intercostal spaces, producing a fistula from which there is a daily oozing, or if it be probable, from the symptoms and signs, that pus is escaping from the pleural cavity into a bronchial tube, and is being gradually expectorated—a mode of cure which, as I have elsewhere stated, is not infrequent in children—thoracentesis may be deferred. In the case of an infant aged six months recently under treatment for empyema of the left side we removed four ounces of pus and washed out the pleural cavity. The opening having closed, and the physical signs indicating the reaccumulation of a considerable quantity of liquid, we were preparing for a second operation when the parents and nurse called our attention to the fact that there were occasional severe attacks of coughing, during which the breath presented a very decidedly purulent odor. Although there was no external expectoration, as the sputum was swallowed, thoracentesis was postponed, and the result justified the decision, for the patient gradually convalesced. Except under circumstances like the above, empyema, when clearly diagnosticated by the employment of the hypodermic syringe, should be promptly treated by evacuation of the pus.

Instruments to be Used, and Mode of Operating.—Ingenious instruments for tapping the chest have been invented by Dr. Chadbourne of New York, Dr. A. M. Phelps of Chateaugay, Franklin co., N. Y., and others, which by India-rubber packing totally exclude air while the operation is performed with facility and little pain. That devised by Dr. Chadbourne has a canula with two arms, one for attachment by means of tubing to the exhausting receiver, and the other is designed to facilitate irrigation of the pleural cavity.

Phelps's apparatus has a third tube, entering the bottle through the stopple, and a glass tube passes from the stopple to nearly the bottom of the bottle. With this apparatus, by reversing the movement of the syringe, the liquid can be withdrawn from the chest, the bottle emptied of it, the water used for irrigation be conveyed into the bottle, from the bottle to the chest, and back into the bottle, without changing the position of the bottle or removing the stopple. I would suggest the use of the trocar and canula instead of the sliding aspirator point, which plays outside the canula, as an improvement in this instrument.

The instrument which I have been in the habit of employing is of simpler construction. The canula is about the size of the smallest needle of Dieulafoy's aspirator—the proper size, in my opinion, for thoracentesis for both sero-fibrinous and purulent exudations. I greatly prefer the use of the exhausting-bottle rather than the exhausting-pump without the bottle, as it is more convenient and produces greater suction from its greater size. The canula is provided with an arm which connects it by tubing with the exhausting-bottle. Beyond this arm the body of the canula, sufficiently expanded to contain India-rubber packing, extends about one and a half inches and is provided with a stopcock. Through this packing the trocar is introduced, and after the puncture it is withdrawn to the stopcock, which is then turned to prevent the admission of air. Then the obturator is introduced in place of the trocar, so as to remove any obstruction which may enter the canula.

The tubing which extends from the arm of the canula to the bottle should be firm, with a somewhat larger bore than that of the canula, and its point of attachment to the bottle should also be provided with a stopcock. A short glass tube introduced into this tubing near the canula is convenient for noticing the character of the fluid, which, if it be thick pus, may flow with difficulty and not reach the bottle. A bottle of sufficient capacity to hold two quarts obviously produces more suction power than one of less size, and is therefore preferable for certain cases, and its sides should be marked to indicate ounces and drachms. The tube which connects the canula with the bottle enters through the stopple, and proceeding from the stopple is another tube similar to the first, to which the syringe is attached. The syringe has two points for attachment to the tube and a double action in its interior, so that attached by one point it exhausts the air from the bottle, and attached by the other point it condenses air in the bottle. The stopcock between the canula and the bottle should always be closed when the syringe is used, whether for exhaustion or condensing. It is very important that this should be constantly borne in mind when working the syringe, or air may be thrown into the pleural cavity and much harm done.

Mode of Operating for Sero-fibrinous Exudations.—In the following remarks I shall state what I consider the best method for performing thoracentesis, having formed my opinion from the cases which I have witnessed and been able to follow in institutions and in family practice. A mode of treatment which may be safe and proper for the adult is not always the best for the child, and, as there are different opinions and different modes of procedure, and as many who are familiar with adult cases recommend similar treatment for the child to that which they have employed with success for the older and more robust cases, I shall advise the abandonment of certain measures which are in common use and the substitution of others. The hypodermic syringe should be first used at the point where it is proposed to perform the operation, the disinfected needle being inserted about one inch, for I hold it unjustifiable to tap the chest without first ascertaining that there are no adhesions at the site selected for puncture, and at the same time ascertaining the character of the liquid. Incision of the skin with the knife and spraying the surface with ether are not required as preliminary treatment, since the puncture is quickly and easily performed with a small trocar and with very little pain. The rule is established by many observations that the operation should be performed in or near the vertical line passing through the angle of the scapula and between the eighth and ninth ribs or one of the adjacent intercostal spaces. I have elsewhere stated that a point a little external to this line is preferable, as the lung is less liable to be injured. The instrument should obviously be inserted no farther than will be sufficient to reach the liquid, and, since from measurements which I have made the thickness of the thoracic wall in rather fleshy children is about half an inch, penetration to the depth of one inch will ordinarily be sufficient to pass the fibrinous layer. We are liable to puncture more deeply than is necessary without some safeguard, and incur the risk of wounding the lung. India-rubber tubing may cover the instrument to within one inch of the end, or a cord may be tied snugly around the instrument at one inch from the tip. The sensation communicated to the fingers will, however, be the best guide to the careful operator as regards the exact depth to which the instrument should be carried. The trocar should now be withdrawn, the obturator introduced in its place, the air exhausted from the bottle, and then the stopcock turned to allow the liquid to escape.

It should flow slowly, as it probably will through so small a canula, but the flow can be regulated by the stopcock. The quantity to be removed depends upon the age and condition of the child, the size of the cavity, and the quantity of the liquid, but if the patient begin to cough or feel uncomfortable after the removal of one-half, or even one-third of the liquid, the canula should be withdrawn. The sensation of insufficient breath is no longer experienced, and the remaining liquid is progressively absorbed. This operation is one of the easiest in surgery, while, with the precautions mentioned above, no ill effect need be apprehended. One operation is, in most instances, all that is required, though if need be it can be repeated after some days, and it is very seldom that the lung does not fully expand to fill the chest if the operation be performed at the proper time.

Mode of Operating for Empyema.—It will aid in understanding this part of our subject to remember that all pleuritic exudations contain pus-cells, and that the only anatomical difference between sero-fibrinous exudations and empyema is in the proportion of these cells. There is, therefore, no fixed and definite boundary-line between the two kinds of exudation. The term "empyema" is, as all know, applied by common usage to the liquid when it contains so many leucocytes or pus-cells that a turbid appearance is imparted to it. Absorption is slow and difficult or impossible if the liquid contain a large amount of solid ingredients—to wit, fibrin and pus-cells—while liquid containing only a small proportion of these constituents more readily enters the absorbents. In other words, thin pus may be absorbed and removed from the system by natural methods, or by the same instrument and operation which we have recommended for sero-fibrinous exudations, while a thick liquid adherent to the pleura or sinking heavily in dependent portions of the cavity disappears very slowly, losing by absorption only a little of the liquor puris, while the bulk of it cannot be absorbed, so that the only relief is by evacuation through an opening. Often in practice, after the acute symptoms of an empyema have in a measure abated, the physical signs indicate some diminution of liquid in successive weeks, but further removal soon comes to a standstill and the resources of surgery must be tried.

The same small trocar and canula, or a little larger, should be used for tapping the chest of an empyemic child which we have recommended for sero-fibrinous exudation and with the same precautions. If the liquid be thin and but slightly turbid, if it be but little removed from sero-fibrin in its character, it will flow through the canula, even if it be necessary to use the obturator often to remove obstructions. Having withdrawn all the liquid which will flow through the opening, unless severe coughing or some unpleasant symptom occur, which is an indication to discontinue the withdrawal, the instrument is removed and the aperture may be closed with adhesive plaster. In exceptional instances, if the pus be thin and the pus-cells few in proportion to the amount of serum, one aspiration may be sufficient to effect a cure: but usually the cavity refills. If the pus be thick, it will almost inevitably refill, and it is better to make a free incision with a bistoury at once. If the pus be thin and the cavity after aspiration refill in a few weeks, free incision is preferable to a second aspiration, for as a rule the lung should not be compressed by pus more than four to six weeks, for by longer compression it might be seriously injured.

Therefore if the chest refill after one or at most two aspirations, an incision should be made with the knife at the same point as that selected for aspiration—that is, between the eighth and ninth ribs and in the line passing perpendicularly through the lower angle of the scapula. An incision should be made with a sharp-pointed bistoury a little nearer the ninth than the eighth rib, sufficiently large to admit the blunt-pointed bistoury, and with this the incision should be extended to the distance of one-third to one-half inch, which will allow the pus to flow out freely. The opening should then be covered by oakum confined by long strips of adhesive plaster. Pus may or may not continue to flow into the oakum. If it do not, the opening will close, if left to itself, within two or three days. No tent or drainage-tube is employed, for reasons to be mentioned hereafter. The physician should return after twelve or twenty-four hours, not later, and should introduce through the opening the ordinary gum-elastic male catheter, warmed so as to be flexible and strongly bent at its middle. The point should be directed to the bottom of the cavity. Perhaps the soft rubber catheter might be preferable, but I have never used it, being satisfied with the other. The catheter should be attached by tubing to the exhausting-syringe or bottle, and any pus in the depending portions of the cavity will be readily removed. I have generally at this visit removed from the bottom of the cavity two or three ounces, sometimes very thick, and such as would not readily flow from the opening. Every day or twice daily the operation should be repeated; which will, I think, more effectually remove the pus than washing out the cavity, and the opening cannot close. This operation detains the physician only a few moments. The catheter should be a No. X., and it is the best possible probe. By the close of the first week the opening becomes fistulous.

After each removal of the pus long strips of adhesive plaster firmly applied over the ribs, from the sternal region downward and backward, facilitate approximation of the pleural surfaces and obliteration of the cavity. During convalescence the patient, if old enough, should be directed to make full inspirations, which serve to expand the lungs.

That so simple and important an operation as thoracentesis should have been known and practised by the ancients—even, it is said, by Hippocrates—and have fallen into disuse till it was revived in our own times by Bowditch and Trousseau seems remarkable. This was probably in part due to the bad instruments employed, and in part to the fact that in olden times the operation was performed in the anterior walls of the chest, where adhesions are frequently present. But there are certain accidents and unfavorable results of the operation which may be profitably considered, since they can nearly always be avoided:

1st. *The Admission of Air into the Pleural Cavity.*—This is unnecessary and can be avoided; but those who have often witnessed the operation as ordinarily performed have remarked the fact that the admission of more or less air is common.

The entrance of a certain amount of air into a serous cavity when the serous membrane is in its normal state does not appear to be productive of harm with ordinary precautions as regards temperature, etc., as in ovariotomy, in which air is admitted into the largest serous cavity in the body; and the moderate admission of air into the pleural cavity when the pleura is healthy does not, as a rule, produce any ill effect. Thus, a case is related of a man who suffered from heart disease, and was led to think that the pressure of a small amount of air internally might be substituted for external pressure, which always gave relief.[1] He was his own instrument-maker and operator. He constructed a small tube about as slender as a common pin, to which a bladder was attached filled with air. The point of this was thrust through an intercostal space till it penetrated the pleural cavity, and air was made to enter by compressing the bladder. Relief always followed and the patient's health improved. This treatment was continued two or three years. Dr. Lizars, who was present at the meeting of the medical society before which this case was related, stated that he had performed a similar operation on four or five patients affected with aneurisms, with some apparent benefit and in no case with injury.

But the condition is very different if there be inflammatory products in the cavity. It is a fact known to all observers that animal liquids withdrawn from the circulation and escaped from the vessels through injury or disease remain in a closed cavity for a lengthened period without putrefactive change—as, for example, a clot of blood under the scalp or pericranium of a new-born infant—but if air be admitted it becomes offensive within a few hours. The admission of air into the pleural cavity which contains exuded products undoubtedly promotes putrefactive changes in the latter, and the admission of even a small amount of air, containing, as it does, micro-organisms which multiply rapidly in the animal fluids, and which appear to be the active agents in putrefaction, suffices to convert sero-fibrin or laudable pus into an offensive, irritating, and poisonous liquid, which increases the constitutional disturbance and the gravity of the disease.

Air in the pleural cavity, in proportion to its quantity, also tends to prevent the approximation to each other of the pleural surfaces and the obliteration of the cavity, which is required in all empyemic cases, since this is the mode of cure. Obviously, the entrance of air does less harm if there be a fistulous opening and pus escape as soon as it forms than in a closed cavity, but it should in all instances be avoided, as never beneficial and likely to do harm in the manner indicated. It is never a necessary accident of thoracentesis, since it can be avoided by the use of proper instruments provided with India-rubber packing and stopcocks. There can be no doubt, also, that the point of the aspirator has often so pricked and torn the lung that air has cavity disappears very slowly, losing by absorption only a little of the liquor puris, while the bulk of it cannot be absorbed, so that the only relief is by evacuation through an opening. Often in practice, after the acute symptoms of an empyema have in a measure abated, the physical signs indicate some diminution of liquid in successive weeks, but further removal soon comes to a standstill and the resources of surgery must be tried.

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[1] *London Lancet*, January 15, 1831.

The same small trocar and canula, or a little larger, should be used for tapping the chest of an empyemic child which we have recommended for sero-fibrinous exudation and with the same precautions. If the liquid be thin and but slightly turbid, if it be but little removed from sero-fibrin in its character, it will flow through the canula, even if it be necessary to use the obturator often to remove obstructions. Having withdrawn all the liquid which will flow through the opening, unless severe coughing or some unpleasant symptom occur, which is an indication to discontinue the withdrawal, the instrument is removed and the aperture may be closed with adhesive plaster. In exceptional instances, if the pus be thin and the pus-cells few in proportion to the amount of serum, one aspiration may be sufficient to effect a cure: but usually the cavity refills. If the pus be thick, it will almost inevitably refill, and it is better to make a free incision with a bistoury at once. If the pus be thin and the cavity after aspiration refill in a few weeks, free incision is preferable to a second aspiration, for as a rule the lung should not be compressed by pus more than four to six weeks, for by longer compression it might be seriously injured.

Therefore if the chest refill after one or at most two aspirations, an incision should be made with the knife at the same point as that selected for aspiration—that is, between the eighth and ninth ribs and in the line passing perpendicularly through the lower angle of the scapula. An incision should be made with a sharp-pointed bistoury a little nearer the ninth than the eighth rib, sufficiently large to admit the blunt-pointed bistoury, and with this the incision should be extended to the distance of one-third to one-half inch, which will allow the pus to flow out freely. The opening should then be covered by oakum confined by long strips of adhesive plaster. Pus may or may not continue to flow into the oakum. If it do not, the opening will close, if left to itself, within two or three days. No tent or drainage-tube is employed, for reasons to be mentioned hereafter. The physician should return after twelve or twenty-four hours, not later, and should introduce through the opening the ordinary gum-elastic male catheter, warmed so as to be flexible and strongly bent at its middle. The point should be directed to the bottom of the cavity. Perhaps the soft rubber catheter might be preferable, but I have never used it, being satisfied with the other. The catheter should be attached by tubing to the exhausting-syringe or bottle, and any pus in the depending portions of the cavity will be readily removed. I have generally at this visit removed from the bottom of the cavity two or three ounces, sometimes very thick, and such as would not readily flow from the opening. Every day or twice daily the operation should be repeated; which will, I think, more effectually remove the pus than washing out the cavity, and the opening cannot close. This operation detains the physician only a few moments. The catheter should be a No. X., and it is the best possible probe. By the close of the first week the opening becomes fistulous.

After each removal of the pus long strips of adhesive plaster firmly applied over the ribs, from the sternal region downward and backward, facilitate approximation of the pleural surfaces and obliteration of the cavity. During convalescence the patient, if old enough, should be directed to make full inspirations, which serve to expand the lungs.

That so simple and important an operation as thoracentesis should have been known and practised by the ancients—even, it is said, by Hippocrates—and have fallen into disuse till it was revived in our own times by Bowditch and Trousseau seems remarkable. This was probably in part due to the bad instruments employed, and in part to the fact that in olden times the operation was performed in the anterior walls of the chest, where adhesions are frequently present. But there are certain accidents and unfavorable results of the operation which may be profitably considered, since they căn nearly always be avoided:

1st. *The Admission of Air into the Pleural Cavity.*—This is unnecessary and can be avoided; but those who have often witnessed the operation as ordinarily performed have remarked the fact that the admission of more or less air is common.

The entrance of a certain amount of air into a serous cavity when the serous membrance is in its normal state does not appear to be productive of harm with ordinary precautions as regards temperature, etc., as in ovariotomy, in which air is admitted into the largest serous cavity in the body; and the moderate admission of air into the pleural cavity when the pleura is healthy does not, as a rule, produce any ill effect. Thus, a case is related of a man who suffered from heart disease, and was led to think that the pressure of a small amount of air internally might be substituted for external pressure, which always gave relief.[1] He was his own instrument-maker and operator. He constructed a small tube about as slender as a common pin, to which a bladder was attached filled with air. The point of this was thrust through an intercostal space till it penetrated the pleural cavity, and air was made to enter by compressing the bladder. Relief always followed and the patient's health improved. This treatment was continued two or three years. Dr. Lizars, who was present at the meeting of the medical society before which this case was related, stated that he had performed a similar operation on four or five patients affected with aneurisms, with some apparent benefit and in no case with injury.

But the condition is very different if there be inflammatory products in the cavity. It is a fact known to all observers that animal liquids withdrawn from the circulation and escaped from the vessels through injury or disease remain in a closed cavity for a lengthened period without putrefactive change—as, for example, a clot of blood under the scalp or pericranium of a new-born infant—but if air be admitted it becomes offensive within a few hours. The admission of air into the pleural cavity which contains exuded products undoubtedly promotes putrefactive changes in the latter, and the admission of even a small amount of air, containing, as it does, micro-organisms which multiply rapidly in the animal fluids, and which appear to be the active agents in putrefaction, suffices to convert sero-fibrin or laudable pus into an offensive, irritating, and poisonous liquid, which increases the constitutional disturbance and the gravity of the disease.

Air in the pleural cavity, in proportion to its quantity, also tends to prevent the approximation to each other of the pleural surfaces and the obliteration of the cavity, which is required in all empyemic cases, since this is the mode of cure. Obviously, the entrance of air does less harm if there be a fistulous opening and pus escape as soon as it forms than in a closed cavity, but it should in all instances be avoided, as never beneficial and likely to do harm in the manner indicated. It is never a necessary accident of thoracentesis, since it can be avoided by the use of proper instruments provided with India-rubber packing and stopcocks. There can be no doubt, also, that the point of the aspirator has often so pricked and torn the lung that air has entered the cavity from this organ—a result avoided by judiciously using the trocar and canula.

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[1] *London Lancet*, January 15, 1831.

2d. *Injury to the Lung by the Surgical Instruments Used.*—The lung is sometimes injured by the point of the hypodermic needle employed for diagnosis. Cases are reported in the hospitals of New York of the breaking off and loss of the needle in the lung from sudden and strong movement of this organ, as in coughing. The most severe injury is, however, commonly produced by the aspirator needle, and some very serious cases of this accident have occurred in which the needle so pierced and tore the lung that not only air escaped from it, but also a considerable quantity of blood. It is obvious that the danger of injuring the lung is greater in recent than in chronic cases, and greater in sero-fibrinous than in purulent pleuritis, for a thickened, infiltrated, and firm pleura affords protection to the lung. It is very difficult to avoid injuring this organ if suction be made and the liquid be withdrawn with the unguarded point of the aspirator needle projecting into the chest. The removal of the liquid necessitates the impinging of the lung upon the point of the instrument even if it be held very obliquely, and in recent cases, when there is a little thickening and infiltration of the pleura, the surface of this organ may be pricked or torn sufficiently to allow air to escape and hemorrhage occur, when the operator who holds the needle can scarcely believe that such an accident were possible, so slight has been the sensation communicated to the fingers. Thus, thoracentesis was performed on an infant of two months who had severe empyema of short duration. The instrument was held by myself obliquely, and it entered the pleural cavity only a short distance, and yet the lung was injured in three places, from which it was probable, from the signs and symptoms, that air had escaped. The specimen showing the injury was exhibited to the Pathological Society in 1879. Obviously, to prevent this injury aspiration should be performed through the covered needle, as that of Phelps's or Potain's, or the trocar, which I have recommended above and prefer. I must here repeat what has been stated above, not to plunge the trocar to a greater depth than is needed, which is about one inch. The end of the canula may also injure the lung if it be pressed in too deeply, since it is necessarily rather sharp from its small size.

3d. *Washing out the Pleural Cavity.*—Since the aspirator has come into general use, it is the common practice to wash out the pleural cavity with carbolized water in the treatment of empyema. The proportion of carbolic acid to water commonly employed is about one part to eighty, and at a temperature of 100°. From a discussion at the meeting of the New York Surgical Society, Oct. 12, 1880, it appears that the use of carbolized water involves risk of carbolic-acid poisoning in case the liquid be only partially removed after it is thrown into the pleural cavity; and the late Prof. Erskine Mason was in the habit of employing salicylic acid, one part to the hundred of water, in place of carbolic acid, since it possesses all the advantages with none of the possible risks of the latter. He stated that it promptly deodorizes fetid pus even in the proportion of one part to two hundred. The use of carbolic acid would probably be entirely safe if the liquid were removed immediately after washing the cavity, but for some reason this is not always possible. In case of an infant with empyema under treatment by Drs. Lockrow, Billington, and myself, after removing the pus by trocar and canula attached to the exhausting-bottle, and once washing out the pleural cavity, the liquid was thrown in a second time, ℥iij, into the left pleural cavity of an infant of five months, but not a drop of it could be removed. There was, however, no symptom which we could refer to the carbolic acid. In view of these facts and the possible danger of carbolic-acid poisoning, the use of salicylic acid appears to be preferable, at least for children, who are less able to resist the action of poisonous agents than adults.

In this connection I must state my conviction that washing out the pleural cavity is unnecessary if empyema be treated as recommended above, and it may be injurious. But it is proper treatment when the pus has undergone decomposition, is offensive to the smell, and therefore poisonous. If it be putrid, its immediate disinfection as well as removal from the pleural cavity appears to be clearly indicated, but in the common form of empyema, as the pus escapes through the opening which has been made and the suppurative cavity becomes smaller, adhesions of the pulmonary and costal surfaces occur, which the injection of water may tear up and destroy, and thus the obliteration of the cavity is retarded. Letting out the pus and approximation of the pleural surfaces to each other are the indications as regards surgical measures. Besides, washing out the pleural cavity is not devoid of danger. Alarming symptoms may be developed unexpectedly and rapidly, even when the operation is slowly and cautiously performed. The infant of five months with empyema whose case I have alluded to furnished a striking example of this. Four ounces of pus had been removed through a small canula from the left pleural cavity, and without removing the canula the cavity had been once washed out. It was proposed to repeat the washing, as the infant had thus far tolerated the operation and was in an unusually favorable state for a case of empyema. The patient was in a semi-erect position, and three ounces of water at a temperature of 100° had entered the cavity from the inverted bottle, when he began to cough, fretted, and became very restless. Immediately, Dr. Lockrow applied the suction-point of the syringe to the tubing, and attempted to withdraw the liquid, but with no result. The patient's face assumed a deadly pallor, he frothed at the mouth, his lips were compressed, and breathing ceased. He was to all appearances dead. He was immediately placed upon the back by Dr. Billington, and by prompt resort to artificial respiration the terrible suspense was soon ended by the gasps of the child and the return in a few moments of consciousness and normal respiration. It seemed to me that this untoward accident was due to the flow of water against the heart, so that it prevented full dilatation of its cavities, and consequently diminished the flow of blood into the aorta and produced anæmia of the brain. Lichtenstern says: "Various causes which sometimes quite interrupt or impede the flow of blood to the left heart, such as severe paroxysms of coughing, vomiting, lifting heavy burdens, may give rise to a suddenly fatal anæmia of the left heart, and secondarily of the brain. The anæmia of the lungs or brain found in many cases is only of secondary importance. It frequently happens after thoracentesis with aspiration that an anæmia is produced in the partially distended lung, and this may lead to death by asphyxia. In sudden death during, immediately, or a short time after thoracentesis by aspiration the cause is anæmia, either of the heart or brain. In cases in which severe syncope and sudden death are observed during the irrigation of the pleural cavity the cause is either direct mechanical concussion of the easily-exhausted heart by the stream of water thrown in, or shock."[1]

4th. *The Use of Tent and Drainage-tube in Empyema.*—With due regard for the opinions of the experienced surgeons who employ and recommend the tent and drainage-tube, but whose observations have been largely upon adult cases of empyema, I cannot recommend their employment for children, unless perhaps the tent for a day or two after the incision; but the tent is not necessary if the catheter be daily introduced in the manner which I have advised.

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[1] *Deutsches Archiv für klin. Med.*, Band iv., 4 Heft.; *London Med. Record*, Dec. 15, 1880.

The drainage-tube almost necessarily admits air during inspiration, but this is not the most serious objection to it. Cachectic children with poorly nourished tissues badly tolerate pressure upon an open wound by a hard substance. It is liable to cause ulceration and enlarge the opening, and continued pressure of the tube may cause periostitis upon the edge of the rib and necrosis. Scrofulous and feeble children are very prone to both caries and necrosis from even slight pressure or bruises upon the surface of the bone—a result to which adults are much less liable. In a paper published by Mr. W. Thomas[1] on the treatment of empyema by resection of one or more ribs, 9 cases are detailed, in 3 of which necrosis had occurred from pressure, it is stated, of drainage-tubes, thus necessitating the removal of the diseased portion. During the year 1881 a wasted empyemic infant was brought to one of the institutions of this city for treatment. After letting out the pus a drainage-tube was introduced and secured. At the next visit ulceration had so enlarged the opening that a large amount of air entered the chest with a whistling noise at each inspiration, and was expelled during expiration, and necrosis of the portion of the rib against which the tube pressed had also occurred. Air was finally excluded by covering the opening with a cloth smeared on each side with a concentrated solution of gutta-percha in chloroform, but the case after some days ended fatally. The escape of the drainage-tube into the pleural cavity, which has occurred by breaking of the threads which secured it, is so rare an accident that it does not constitute an objection to the introduction of the tube; but aspiration daily or twice daily through the catheter so completely removes the pus that drainage is not required, and the risk of injury by the pressure of the tube is therefore avoided.

5th. I have witnessed in a few instances the burrowing of pus under the skin at the point where an incision had been made to let out the pus. This complication may lead to more or less ulceration or sloughing, and it greatly increases the danger of poisoning. But infiltration of pus will almost never occur if the incision be direct through the tissues, and not with the skin pushed to one side, so that it forms a covering or valve when it returns, as was once recommended in the books as a means of excluding air. But air does not enter the cavity through a direct opening if it be properly covered after the pus has escaped. Burrowing of pus and pyæmic poisoning therefrom cannot then be regarded as an accident of the mode of operation which I have recommended.

Exsection of a Portion of One or More Ribs.—This operation has now been performed a considerable number of times in Europe and in this country, and, from the published accounts, certain cases have apparently recovered more rapidly in consequence. Thus in one case a fistulous opening, spontaneously established, had continued several months with little diminution in the discharge and very slow progress toward recovery, when by this operation, which produced a larger opening and a freer escape of pus and falling in of the chest-wall, so as to obliterate the cavity, the patient rapidly convalesced.

The alleged benefit from the exsection, which consists in the removal of an inch or a little more of one or more ribs in or near the site for the usual performance of thoracentesis, is, that there is a readier escape of pus and the facility for washing out the pleural cavity is increased, and the thoracic wall and lung are more readily approximated, so as to produce obliteration of the pleural cavity. The greatest benefit is claimed for it in those cases in which the intercostal spaces are small and the ribs lie close to each other.

Without denying that certain cases have apparently been benefited by the operation, I must say that I have not yet met a case, either in family or hospital practice, in which I could conscientiously recommend the operation, except where necrosis had occurred from a periostitis produced by the irritating property of the pus or the pressure of a drainage-tube. The gum-elastic catheter, introduced as recommended above, will pass through any intercostal space which I have yet observed, so as to allow free evacuation of the pus by suction, if it be not incapsulated by fibrinous bands, and allow also the free washing out of the pleural cavity if this be desired.

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[1] *Birmingham Med. Rec.*, 1880, N. S. vol. iii.

There are also serious objections to the exsection in case of a child. The system, exhausted by suppurative inflammation, is in poor condition to tolerate an operation of any severity, and, although we are directed to preserve as far as possible the periosteum from injury by the knife, and be careful not to wound the intercostal vessels, there are necessarily more or less shock and hemorrhage and consequent danger of hastening the death of the patient. In one of the cases, that of an infant, reported by an advocate of the operation, it seems to me that death was largely attributable to the exsection.

In order that exsection aid materially in the approximation of the lung and ribs, it is necessary to remove portions of two or more ribs, and the greater the operation the greater the risk. But what is needed is not depression of the ribs, which may produce permanent deformity, but expansion of the lung, and this is promoted by the integrity and resiliency of the ribs.

CHAPTER IX.

NERVOUS COUGH.

A NERVOUS cough sometimes occurs in children, especially between the ages of two or three and ten years. It may result from disease of the brain, from the second as well as first dentition, from some irritant in the intestines, as worms, and also from spinal irritation. Irritation in the external ear from the presence of a foreign substance excites a cough in some children. A similar fact is noticed by many adults—namely, that attempts to remove the wax from the ear by an instrument excites a cough. Occasionally there appears to be no local cause, but a state of anæmia or a highly developed nervous temperament, to which it seems proper to ascribe the cough. Occurring under these last circumstances, it corresponds with, and is sometimes accompanied by, functional disturbance in the action of the heart, as palpitation.

A nervous cough is short, painless, and without expectoration. It usually attracts little attention at first, but from its long duration the friends finally become anxious lest it betoken some serious disease. At times it may nearly subside if the patient lead a quiet life and the general health improve, and there are periods of recrudescence if the opposite conditions obtain. It may have a spasmodic character, especially in times of mental excitement, but in a less degree than the cough of pertussis. If not properly treated it usually continues several weeks or months, disappearing as the general health and the tone of the nervous system improve. It is not in itself a serious disease, nor does it lead to any ailment or produce any injury of the respiratory organs, but it is an unpleasant malady, and is liable to be mistaken for incipient tuberculosis if it occur in one decidedly cachectic and belonging to a family predisposed to phthisis.

TREATMENT.—If there be a local cause of the cough, measures calculated to remove this, or at least to palliate its effects, are obviously required. Especially should constipation or any abnormality in the digestive function be corrected. But in many cases there is no apparent local ailment which produces the cough by its irritative action, and the remedial measures must then be twofold—to wit, first, those designed to improve the general state; and, secondly, those designed to relieve the cough. Such measures are also required in most cases in which there is a local cause, provided that the cough do not cease when treatment calculated to remove this cause has been employed.

For constitutional treatment no remedy is so useful in ordinary cases as iron. The following example shows the benefit which may result from the use of this agent, since in this case it effected a cure without the aid of other measures: B——, aged eleven years, pallid and of spare habit, but active and with good appetite, had been treated for this malady by different physicians but without improvement. His mother had died of tuberculosis, and some at least of the physicians believed that he was in the commencement of the same disease. Finally, he was placed under the care of the late Dr. Cammann, who, detecting the nature of the malady, wrote the following prescription:

℞. Ferri. subsulphat., ʒss;
Acid. nitric., fʒss;
Aq. destillat., f℥ss. Misce.
Dose: Three drops four times daily in sweetened water.

The cough disappeared in a surprisingly short time. If the appetite be poor, the vegetable tonics are required in combination with iron.

If the cough be frequent and troublesome, medicines which exert a direct controlling effect upon it are required in addition to the treatment employed to improve the general state. For this purpose no remedy is so useful as the bromides, employed alone or in combination with belladonna. If there be no decided anæmia, and no local cause of the cough, the bromides and belladonna usually effect a cure without the employment of constitutional measures, or if the case seem to require iron it may be given in the interval. The following is the prescription for a child of three years:

℞. Tinct. belladonnæ, gtt. xxxij;
Potas. bromid.,
Ammon. bromid., *āā.* ℥j;
Syr. simplic., ℥ij. Misce.
Dose: One teaspoonful three times daily.

In 1871, I was asked to prescribe for a German boy, aged eight and a half years, who had a cough of this kind of two months' duration, which latterly had been frequent and annoying. Within a week he was entirely relieved without other remedy by the employment of tincture of belladonna, drops v, and bromide of ammonium, gr. v, twice daily. Outdoor exercise or country residence and other regimenal measures which improve the general health are useful in ordinary cases.

SECTION III.

DISEASES OF THE DIGESTIVE APPARATUS.

CHAPTER I.

SIMPLE STOMATITIS, ULCEROUS STOMATITIS, FOLLICULAR STOMATITIS.

DISEASES of the digestive system are very frequent in infancy and childhood. They are for the most part readily recognized, and are more easily and quickly controlled by therapeutic agents, if rightly applied, than are the diseases of any other system. If misunderstood and improperly treated, they may, even when mild and very manageable in their commencement, become chronic and obstinate, or even fatal, or they may lead to other and more dangerous diseases. It is necessary, then, that the physician should understand thoroughly the pathology as well as therapeutics of the digestive system, that he may make timely and correct use of the required remedies.

The diseases of the buccal cavity in early life are for the most part inflammatory, one of the most interesting of which—to wit, sprue or thrush—we have already treated of among the diseases of the newly-born. The mildest of these diseases is that known as

SIMPLE OR CATARRHAL STOMATITIS.

This form of catarrh occurs usually before the completion of the first dentition, and it is most frequent under the age of one year. Giving rise in itself to no severe symptoms, and often being connected with other grave and dangerous maladies, it is, doubtless, in many cases overlooked. It is sometimes confined to a portion of the buccal surface or is more intense in one part than in another. In other cases the catarrh is uniform or nearly so, affecting the entire cavity of the mouth.

CAUSES.—The common cause of simple stomatitis in infants is the same as that of most cases of gastro-intestinal inflammation at that age. This is the use of indigestible and therefore irritating food, uncleanliness, personal and domiciliary; in fine, all those agencies which impair the general health and enfeeble the digestive organs. Therefore, stomatitis, like entero-colitis, is more common in the city than in the country, and among the city poor than those in the better walks of life. Infants deprived of the mother's milk and given a diet which, with all care of preparation, is a poor substitute for the natural aliment, are very liable to this disease. Beaumont ascertained from his experiments on St. Martin that irritative changes produced in the stomach by indigestible substances were soon followed by similar changes in the buccal mucous membrane. Since in young infants any kind of artificial food is less digestible than breast-milk, it is evident why those who are prematurely weaned or are carelessly fed are so liable to stomatitis. This inflammation is also sometimes due to irritating substances taken into the mouth, as drinks habitually too hot or too cold. Stomatitis is also present in measles and scarlet fever. It then corresponds with the cutaneous eruption, and disappears when that subsides.

Another cause is dentition. The gum over the advancing tooth first becomes inflamed, and, other causes perhaps conspiring, the inflammation extends over more or less of the buccal surface. When due to dentition the stomatitis is more frequently partial than when it arises from a constitutional cause. Mercury, in whatever form introduced into the system, excreted from the salivary glands and flowing over the buccal surface, is an occasional though, now-a-days, rare cause.

SYMPTOMS; APPEARANCES.—Stomatitis, like other mucous inflammations, is characterized by increased redness and more or less thickening of the inflamed buccal membrane, by rapid proliferation and exfoliation of epithelial cells, and by an increased functional activity of the muciparous follicles. The heat of the mouth is sometimes augmented in an appreciable degree. The gums in severe cases are swollen and spongy, and bleed readily if rubbed or pressed. The tongue is usually covered with a light fur, and the salivary secretion is frequently augmented to such an extent as to dribble from the corners of the mouth. Often there is little suffering, but in other instances the patients are fretful, experience pain from the contact of solid food, and, if nursing, may even wean themselves from dread of pressure of the nipple.

Simple stomatitis is not difficult of detection, provided that attention be directed to the mouth. Inspection informs us of its presence and extent. A favorable termination may be confidently predicted, unless there be a state of marked cachexia or a grave coexisting disease. If circumstances are unfavorable, simple stomatitis may terminate in a more severe form, as the ulcerous or diphtheritic.

TREATMENT.—The physician should endeavor to ascertain the cause, and, if possible, should remove it by appropriate medicinal and hygienic measures. Sometimes no special treatment is required, as in measles or scarlet fever. When the primary affection terminates the stomatitis disappears of itself. If dentition be the cause and there be much fever and fretfulness, it has been the common practice to scarify the gums, but this operation is not often advisable. A few doses of bromide of potassium relieve the fretfulness, and mucilaginous and mild astringent lotions suffice for the catarrh. Borax is a good local remedy used either with honey or with glycerin and water—one part of borax to three of honey, or a drachm of borax to an ounce of water and two drachms of glycerin. A weak solution of alum is also a useful topical remedy. With either of these agents in a favorable condition of system, and without any serious coexisting disease, the stomatitis is relieved.

ULCEROUS STOMATITIS.

In ulcerous stomatitis the anatomical characters are those of severe simple stomatitis, with the additional element which gives it the name by which it is designated.

The inflammation usually begins upon the gums and extends along the buccal surface. Little white points soon appear upon the under surface of the mucous membrane, producing slight prominence of it. These points, which are inflammatory exudations, mainly fibrinous, gradually enlarge.

Some unite and give rise to large irregular ulcerations; others remain isolated, producing ulcers which are smaller and of more regular shape. There is, indeed, no uniformity as regards the size and form of the ulcers. In the folds of the buccal membrane they are usually elongated, while inside the lips or where the surface is smooth the circular or oval form predominates. It is a noteworthy fact that the exudation underlies the mucous membrane, obstructing its nutrient vessels, so that the ulcer which results causes destruction of the mucous layer and cure is effected by cicatrization.

Ulcerous stomatitis is usually confined to that part of the buccal surface which covers the gums or is in their immediate vicinity, but in some instances it affects nearly every part of the cavity of the mouth.

If the disease be severe, considerable swelling occurs around the ulcers, but the swollen part is soft and cushiony and not very tender on pressure. The soft and yielding nature of the swelling serves as a means of diagnosis between this disease and the premonitory stage of gangrene, since in the latter affection the swollen part is more indurated.

If the disease grow worse, more ulcers appear, and those already present grow deeper and wider and their edges more vascular.

If, on the other hand, there be improvement, the swelling subsides, the ulcers become more clean, their bases approach the level of the mucous membrane, and present a granulating appearance. Finally, the mucous layer is reproduced. A considerable time after the ulcers are healed the new membrane which occupies their site has a redder hue than the adjacent surface.

CAUSES.—Ulcerous like simple stomatitis is most frequent in the families of the poor. Personal uncleanliness, poor food, a residence in apartments dirty, humid, or in other respects insalubrious, favor its development. In fine, a cachectic condition, however produced, is a common predisposing cause. Ulcerous stomatitis frequently occurs when the system is reduced or enfeebled by acute diseases, as after the essential fevers and thoracic and intestinal inflammations. In protracted entero-colitis of infants it is sometimes severe and obstinate, and a case in which this complication arises usually ends unfavorably. The abuse of mercury is an occasional cause of this form of stomatitis, as well as of simple catarrh. Jaccoud states that Bergeron established the fact that ulcerous stomatitis is propagated among soldiers by contagion, and he adds "it is very probable that it is the same in infants."

SYMPTOMS.—The symptoms in ulcerous stomatitis are more severe than in the simple form. There are more pain, more salivation, and more fretfulness. The ulcerated surface is sometimes very tender, so that there is but little sleep. Drinks, unless bland and lukewarm, are painful, and if the ulcers be on the lips or the front of the mouth the infant nurses less eagerly than usual, and even with reluctance, sometimes weaning itself. Occasionally the submaxillary glands are tumefied, hard, and tender. The breath has an offensive odor. In mild cases, in which the stomatitis is of limited extent, this odor may scarcely be noticed, but in severe cases it is almost like that exhaled from putrid substances. The fever is in most instances slight.

PROGNOSIS.—A favorable prognosis may be given unless the patient be in a decidedly cachectic condition or there be a serious coexisting disease, under which circumstances the case may be protracted. If death occur it is due to the cachexia or to some pathological state quite distinct from the stomatitis, most frequently entero-colitis. Ulcerous stomatitis when the ulcers are small and the inflammation of limited extent is of course more easily cured than when it is extensive and the ulcers are large.

This disease is very liable to return unless the general health be good.

TREATMENT.—The physician should endeavor to ascertain the cause of the stomatitis, and so far as possible should remove the patient from its influence. It is often necessary, in order to ensure speedy recovery, to recommend a change in regimen, especially as regards diet and cleanliness. If the patient live in damp, dark, and dirty apartments, the family should seek a better residence, and he should be taken daily into the open air.

Tonic remedies are generally required. The ferruginous preparations may be advantageously given, or the vegetable tonics, or the two in combination. In selecting the internal remedies we must regard the antecedent disease, if there be any, which the buccal inflammation complicates and on which it depends. For that large proportion of cases in which there is chronic intestinal inflammation the liquor ferri nitratis, with tincture of colombo, administered in simple syrup, will be found useful. For local treatment Trousseau recommends occasional applications of nitrate of silver or muriatic acid as a caustic, and in the intervals a wash of equal parts of borax and honey.

The chloride of lime is also considerably used in Paris. It is recommended by Rilliet and Barthez. It is applied dry to the ulcerated surface twice daily, and in the interval the mouth is washed with simple water. This treatment is continued till the ulcers present a healthy appearance and begin to cicatrize. Then a weak solution of chloride of lime is employed, one grain to forty-five of the vehicle. By this treatment a cure is usually effected. Bouchut prefers using chloride of lime with honey, one drachm to the ounce.

But painful applications are not required. The remedy which is most employed in this country and in Great Britain is chlorate of potassium. It often acts like a specific for this as well as other forms of stomatitis. It may be given dissolved in water with sugar or with one of the syrups, to render it more palatable. The dose is about two or three grains every two hours. It should be allowed to run over the affected part, as it is believed to have a local action.

℞. Potass. chlorat.,	ʒss-j;
Mellis,	℥ss;
Aquæ,	℥ij.

One teaspoonful every two hours.

Of all topical remedies in common use, chlorate of potassium is probably the most efficacious. Some physicians prefer the chlorate of sodium on account of its greater solubility. If this wash be too painful in consequence of the irritable state of the ulcers, it may be mixed with mucilage or be employed less frequently, and borax applied in the interval.

APHTHOUS STOMATITIS.

Aphthous stomatitis may occur at any age, but it is most frequent in childhood. It is sometimes designated follicular stomatitis, but the disease affects the contiguous mucous surface as well as the seat of the follicles. At first a vascular injection is observed, and within a few hours a whitish exudation occurs immediately under the epithelium and upon the corium in small round or oval isolated spots. The smallest of these patches are not larger than a pin's head, but most of them have a diameter of one or two lines, and they cause slight prominence of the surface. In two or three days the exudation softens, and the epithelium which covers it is thrown off, producing an ulcer, superficial, without induration of its edges, but sensitive to the touch. It heals in one or two weeks, leaving only a reddish spot or stain, which soon fades. Sometimes two or more aphthæ unite, forming a patch and an ulcer of correspondingly large size. The seat of aphthous stomatitis is usually the internal surface of the lips and cheeks, the gums, tongue, and occasionally the roof of the mouth.

CAUSES.—Probably in most instances the exciting cause is some derangement of the digestive organs which may not be appreciable. We sometimes observe this form of stomatitis in cases of diarrhœa. Occasionally, especially in spring and autumn, two children in a family are affected at the same time, or two or more in a school, so that the disease presents an epidemic character. Children surrounded by bad hygienic conditions, as in the tenement-houses of cities, are more liable to this as well as other forms of stomatitis than are children who live in clean and airy localities and have nutritious and wholesome diet.

SYMPTOMS.—The constitutional symptoms in a large proportion of cases of aphthæ are slight. In twelve children affected with this disease Billard found the pulse from sixty to eighty beats per minute.

The ulcers are painful, as is indicated by the cries of the child when they are pressed, and its fretfulness. Solid food, and even drinks, unless bland and unirritating, are badly tolerated. The salivary secretion is also augmented.

In those rare cases in which the ulcers become confluent or gangrenous the state of the patient is really serious. There is then often gastro-intestinal disease. The symptoms indicate prostration. The pulse is feeble, the countenance pallid, and the body and limbs become wasted.

DIAGNOSIS.—This is easy. The only disease with which it is liable to be confounded is ulcerous stomatitis. In the ulcerous form there is antecedent and accompanying stomatitis affecting a considerable part, if not the entire buccal cavity, while in the follicular form the inflammation is ordinarily confined to the immediate vicinity of the ulcers. The character of the ulcers serves also as a means of distinction. In ulcerous stomatitis there is great variety as to size and form, while in aphthous stomatitis there is great uniformity in both these respects. The small circular ulcers are characteristic of the follicular inflammation. Before the ulcerative stage the circumscribed character of the eruption serves to distinguish this form of stomatitis from other local diseases affecting the cavity of the mouth.

PROGNOSIS.—Aphthous stomatitis usually ends favorably, but if the ulcers became concrete or gangrenous the health is seriously affected, and a more cautious prognosis should be expressed. The unhealthy appearance of the mouth and the real danger are more often due to the depressing effect of some concomitant disease than to the stomatitis.

TREATMENT.—In ordinary aphthous stomatitis, which is discrete and attended by little or no constitutional disturbance, local remedies suffice to cure the disease. Demulcent drinks or applications to the mouth should be used, as the mucilage from gum acacia, marshmallow, or flaxseed. Mild astringent lotions with the demulcent are also beneficial. The mel boracis is one of the best and most agreeable applications. It may be placed in the mouth with a spoon or applied with a camel's-hair pencil. If there be much tenderness of the ulcers, with restlessness, a small quantity of some opiate should be added to the lotion or it may be administered separately.

With this simple treatment the ulcers generally soon heal and the health of the patient is restored. If, however, the ulcers be painful and not disposed to heal, or be healing tardily, they may be touched lightly with a pencil of nitrate of silver, or, as Barrier recommends, hydrochloric acid in honey of roses. This diminishes the tenderness and expedites the healing process. A better remedy is iodoform, two drachms to one ounce of ether, and applied to the ulcers by a camel's-hair pencil.

If, as may in rare cases occur, the ulcerations be numerous and accompanied by considerable fever, there may be symptoms indicative of cerebral congestion or even premonitory of convulsions. In such cases laxatives and the soothing effect of one of the bromides, and sometimes of the warm foot-bath, are required.

If there be an unhealthy appearance of the ulcers, if they gradually enlarge or become concrete or gangrenous, indicating a cachectic state, tonics should be employed with nutritious and easily-digested diet, and antihygienic influences should so far as possible be removed.

CHAPTER II.

GANGRENE OF THE MOUTH.

THE diseases of the mouth which we have been considering are attended by little danger, but the one which we are next to consider is among the most fatal of early life. It is gangrene of a portion of the cheek or gums, or of both. It is described by writers under various names, as cancrum oris, noma, necrosis infantilis, aqueous cancer of infants.

ANATOMICAL CHARACTERS.—Gangrene of the mouth is sometimes preceded by ulceration of the mucous membrane at the point where it is about to commence, but in other cases this membrane is entire. The tissues at the point of attack, which is most frequently the inside of the cheek, become inflamed, thickened, and indurated. The induration extends, and soon the purple hue of gangrene appears and increases. The next stage in the progress of gangrene is sloughing of the portion the vitality of which is lost.

The slough does not present the appearance of uniform decay. While the color is generally dark, there are in the mass fibres of connective tissue, or even blood-vessels, which remain unchanged or are but partly decomposed. After separation or sloughing of the part where the vitality is first lost, the surface of the excavation, if the disease be not checked, has a dark, jagged, and unhealthy appearance. Commencing with the mucous membrane and the tissue immediately underlying it, the disease extends on the one side toward the skin and on the other toward the deeper-seated structures of the jaw. According to Billard, the swelling which precedes and surrounds the gangrene is in great part œdematous.

This disease is occasionally primary, but in a large proportion of cases it is secondary. Occurring secondarily, its symptoms are often masked by those of the antecedent and coexisting affection. Under such circumstances attention is sometimes first directed to the mouth by the loosening of one or more of the teeth or the appearance on the skin of a livid circular spot which indicates the approach of the disease to the cutaneous surface. The mucous membrane presents a dark-red appearance to the distance of a few lines beyond the point of gangrene. It covers tissues which are inflamed and indurated and about to become gangrenous.

The tongue is usually more or less swollen, unless the disease be mild; an offensive odor arises from the gangrene, due to the evolution of sulphuretted hydrogen and other gases. There is great difference in the extent of the destruction and the gravity of the disease in different cases. It may sometimes be arrested by proper applications and a favorable change in the general health of the child at an early period, when there is little loss of substance. In other cases it extends till it perforates the cheek or even destroys a considerable part of the side of the face, and, extending inward, attacks the periosteum of the maxillary bone, destroying the gum and teeth and denuding the alveoli. Recovery, if it take place at all under such circumstances, is with the loss of a portion of the bone and with deformity.

The duct of Steno is sometimes included in the gangrenous portion, but it commonly resists the destructive process and remains pervious.

AGE.—The age at which gangrene of the mouth occurs is usually between two and six years. In 29 cases collated by Rilliet and Barthez, 21 were between the ages of two and six years, and the remaining 8 between six and twelve years. Of the cases which have fallen under my observation, most were between the ages of two and six years. It is seen that the period of greatest frequency of gangrene of the mouth is different from that in which the ordinary forms of stomatitis occur.

Gangrene of the mouth may, however, occur under the age of one year. Billard reported 3 cases under the age of one month, but in 2 of these the disease does not appear to have been sufficiently marked to render it certain that they were genuine cases.

CAUSES.—Gangrene of the mouth usually occurs in those whose systems are reduced or cachectic. It is therefore more frequent among the poor than those in comfortable circumstances—in the city than in the country. It is more frequently observed in asylums for children than in private practice. Most of the cases which I have seen have been in these institutions. If the constitution be good, it can only occur in those long deprived of pure air and wholesome nutriment or those enfeebled by disease.

Among the diseases which have been known to terminate in or be followed by gangrene of the mouth are the pulmonary and intestinal inflammations, whooping cough, and the fevers, both eruptive and the non-eruptive. Rilliet and Barthez have published a table of 98 cases in which gangrene resulted from various diseases. In 49 of these the antecedent disease was measles, in 5 scarlet fever, 6 whooping cough, 9 intermittent fever, 9 typhoid fever, 7 mercurial salivation, and 5 enteritis. It is seen that the essential fevers were the most frequent cause of the gangrene. Of 46 cases collected by MM. Bouley and Caillault the antecedent disease was measles in all but 5. In this city also a larger number result from measles than from any other disease.

One reason why so many cases of gangrene occur as a sequel of measles is probably because this disease is accompanied by stomatitis. Simple or ulcerous stomatitis often precedes gangrene.

Diseases sometimes terminate in gangrene of the mouth in consequence of injudicious treatment which has lowered the vitality of the system. Rilliet and Barthez mention the case of a child four years old in whom gangrene commenced at the twenty-ninth day of primitive pneumonia. The child had been reduced by the application of twelve leeches, three scarifications, a large blister, and by a poor diet.

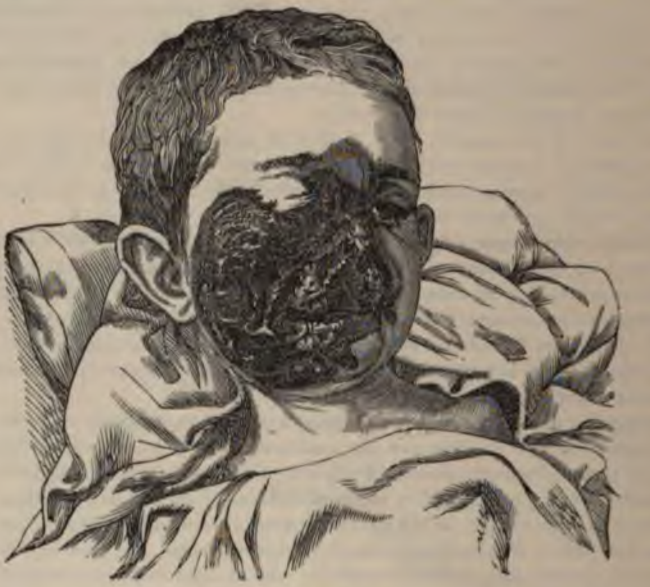
The misuse of mercury was once a much more frequent cause of gangrene than at present, at least in this country, since this agent was formerly much more employed than now. In fact, most of the affections of infancy and childhood in which mercurials were formerly employed are now treated without it.

SYMPTOMS.—Gangrene of the mouth so often occurs in connection with other diseases that its symptoms are in a large proportion of cases blended with those which arise from a distinct pathological state.

There is usually prostration more and more pronounced as the gangrene extends. The features are ordinarily pallid, but occasionally their normal color is preserved for a time; the expression of the face is melancholy, but composed. Sometimes the child is fretful if disturbed; at other times it will quietly consent to an examination. The suffering is not proportionate to the gravity of the disease. There is less pain often than in some of the forms of stomatitis which are unattended with danger.

As the disease advances the body and limbs gradually waste, the eyes are hollow, or, if the gangrene be near the orbit, the eyelids become œdematous; the lips are infiltrated; and both the lips and nostrils are often incrusted. If the cheek be perforated, alimentation is rendered difficult and the appearance of the child is melancholy in the extreme.

FIG. 46.



The tongue is usually moist; it is occasionally swollen. The saliva flows from the mouth, either pure or mixed with offensive sanguinolent matter. Unless the disease be slight there is the peculiar gangrenous odor. The appetite is sometimes poor; at other times it is preserved through the whole sickness. There is no vomiting or looseness of the bowels, unless from a complication. The thirst is usually great, and the pulse is accelerated and feeble except in mild cases.

The skin in the commencement of gangrene is hot. When the vital force is much reduced, and especially as the disease approaches a fatal termination, the face and limbs become cold and the surface generally presents a waxen or ashy appearance. No derangement occurs of the respiratory system. Those cases which are attended by a cough or accelerated respiration are really cases of bronchitis or pneumonia coexisting with the gangrene.

DIAGNOSIS.—Gangrene of the mouth is easily diagnosticated. In those cases in which ulceration precedes the gangrene it may be mistaken in its first stage for that form of ulcerous stomatitis in which the ulcers assume an unhealthy appearance. The following are the distinguishing features of the two affections: Around the ulcer where gangrene is about to commence the tissues are greatly thickened and indurated or œdematous, while ulcerous stomatitis begins with a submucous deposit of fibrin, and is attended by little thickening of the surrounding parts and little or no induration or œdema. In ulcerous stomatitis the skin over the seat of the disease presents its normal appearance, whereas in gangrene it presents a distended and shining appearance. The destructive process in ulcerous stomatitis is also more limited than in gangrene. Deep ulcerations do not occur or are rare. Ulcerous stomatitis is more readily healed, and it leaves no eschar, contraction, or deformity.

The differential diagnosis of gangrene of the mouth from those cases of follicular stomatitis in which the ulcers occupying the seat of the follicles assume a gangrenous appearance must be made by a consideration of the same facts or particulars which serve to distinguish it from ulcerous stomatitis.

Malignant pustule, of rare occurrence in the child, resembles this disease in some of its features. But the pustule always begins on the skin, while gangrene is a disease of the mucous surface primarily. In gangrene, therefore, the chief destruction is of the mucous membrane and of the submucous tissue, while in malignant pustule the chief destruction is of the skin and the subcutaneous tissue.

Prognosis.—This depends not only on the extent of the gangrene, but the nature of the disease, if there be one, which gave rise to it, and the degree of cachexia. If it occur in connection with or as a sequel to one of the less debilitating diseases, and there be considerable vigor of system, it may often be arrested when it has destroyed only the mucous and subcutaneous tissues, so that no deformity results. The friends may congratulate themselves if the case terminate so favorably. In the graver cases, when the gangrene extends until it destroys the periosteum of the maxillary bone on the affected side, and perhaps perforates the cheek, if the child recover it is with the permanent loss of teeth, tedious separation of the necrosed bone, and a cicatrix which may interfere with the free use of the jaw. Death is, however, the more common termination of severe cases. Occasionally the gangrene destroys the continuity of a blood-vessel, causing abundant hemorrhage and accelerating the fatal result. In most cases, however, there is little or no hemorrhage in consequence of coagulation in the vessels.

Another serious complication sometimes arises—to wit, gangrene of other parts, as of the external genital organs. The English editor of Bouchut's treatise on diseases of children relates the following interesting case, from the *Transactions of the Edinburgh Medico-Chir. Society:* An infant eight months old became affected with gangrene of the face, head, and hands. "The right ear and the entire hairy scalp were of an intensely black color, and on both cheeks patches existed about the size of a half-crown piece. The right thumb and the backs of both hands were similarly affected. The child was noted to have been restless and feverish on May 22d, and on the 23d a slightly darkened ring was found to have formed round the thumb, about the middle of the first phalanx; in a few hours the whole thumb was gangrenous and the dorsum of the hand became involved. On the ear the gangrene commenced with the appearance of a flea-bite, and subsequently extended rapidly to the scalp, assuming a remarkably regular form and giving to the child the appearance of wearing a black skull-cap. The pulse was observed to be very feeble. . . . . Death took place in twelve hours from the first appearance of gangrene on the thumb, the child being sensible and continuing to suck well up to a few minutes before death."

Rilliet and Barthez state that pneumonitis frequently occurs in the course of gangrene of the mouth. Such a complication evidently diminishes materially the chance of recovery.

Whether the result be favorable or unfavorable, it is evident from the nature of the disease that the duration is very different in different cases. The physician's attendance may be required for a week or two or for several weeks.

Treatment.—As gangrene of the mouth is eminently a disease of debility, all antihygienic influences should be removed and the most nourishing diet, together with tonics, be recommended. The ferruginous preparations or the bitter vegetables are required.

As soon as the physician is called he should endeavor to arrest the gangrene, accelerate detachment of the slough, and produce a healthy and granulating state of the surrounding tissues. This is best effected by applying a highly stimulating or even escharotic agent to the inflamed surface underneath and around the gangrene. For this purpose a great variety of substances have been used by different physicians, such as acetic, sulphuric, nitric, and hydrochloric acids, nitrate of silver, the acid nitrate of mercury, chloride of antimony, carbolic acid, and even the actual cautery.

M. Taupin recommends, after removing a considerable part of the gangrenous substances with scissors or some instrument, the application of strong muriatic acid, and, when the slough is detached, of dry chloride of lime.

Rilliet and Barthez advise the use twice daily of muriatic acid or the acid nitrate of mercury, applied by a brush upon and around the slough, followed immediately by the application of dry chloride of lime, when the mouth is to be thoroughly washed with water from a syringe. They direct in the interval frequent ablution with water. After the slough has separated, the escharotic is to be discontinued and the chloride of lime used alone. If gangrene extend to the skin, a crucial incision is to be made and the escharotic applied, after which powdered cinchona is introduced and retained by a plaster. This treatment is to be continued till the gangrene is arrested and the decayed portion removed. Barrier, Valleix, and most French writers recommend essentially the same treatment—namely, the application of undiluted escharotic agents.

A safer, less painful, and in many cases successful treatment is that employed by many British and American physicians—to wit, the use of escharotic agents diluted, or, if applied in their full strength, such as are least active and penetrating. Some employ from the first topical treatment which is astringent and stimulating rather than escharotic, and they report satisfactory results.

Dr. Gerhard believes "the best local applications are the nitrate of silver, if the slough be small in extent; if much larger, the best escharotic is the muriated tincture of iron, applied in the undiluted state. After the progress of the disease is arrested the ulcer will improve rapidly under an astringent stimulant, such as the tincture of myrrh or the aromatic wine of the French Pharmacopœia."

The local treatment recommended by Evanson and Maunsell differs from that advised by any of the writers from whom I have quoted. A knowledge of this treatment, from which I have myself seen good results, will be best imparted by quoting from these authors:[1] "The lotion which we have found by far the most successful is a solution of sulphate of copper as employed by Coates in the Children's Asylum. His formula is as follows:

R. Cupri sulph.,	ʒij;
Pulv. cinchonæ,	ʒss;
Aquæ,	℥iv. Misce.

"This is to be applied twice a day very carefully to the full extent of the ations and excoriations. The addition of the cinchona is only useful by retaining the sulphate of copper longer in contact with the edges of the gums. A solution of the sulphate of zinc, ʒj to an ounce of water, by itself or combined with tincture of myrrh, Dr. Coates found to be also useful in some cases."

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[1] *Diseases of Children*, 2d Amer. ed., p. 188.

A moment's reflection will show us that the above treatment is preferable, provided that it is equally effectual in arresting the gangrene, to the treatment by the strong acids which are in common use, and the efficiency of which cannot be questioned.

The purpose in applying the acid is to establish a healthier state of the tissues. It cauterizes and destroys whatever soft tissue it comes in contact with; besides, it produces a strong corrosive action on the teeth and bone. Therefore in gangrene affecting the jaw there is great danger that it will destroy the periosteum, and consequently increase the necrosis.

Dr. West,[1] who advocates the use of the acid, says: "In one of the cases that I saw recover the arrest of the disease appeared to be entirely owing to this agent, though the alveolar processes of the left side of the lower jaw, from the first molar tooth backward, died and exfoliated, apparently from having been destroyed by the acid." No such result follows the use of the solution of sulphate of copper.

In one of these severe cases in which the disease resulted from scarlet fever, and in which there was so much debility that an unfavorable prognosis was made, I succeeded in arresting the disease by the use of Dr. Coates's prescription. The child recovered with the loss of two teeth and the corresponding portion of the maxillary bone. From the good effects which I have observed from iodoform as an application for gangrenous vulvitis following measles it has occurred to me that it may also be useful in gangrene of the mouth.

If, after employing the milder treatment for two or three days, the gangrene continue to spread, the strong muriatic acid should be cautiously applied by a camel's-hair pencil or small swab in such a way that it comes in contact only with the diseased surface. Its use should be immediately followed by an alkaline wash, as a solution of sodium bicarbonate.

In 1881 an epidemic of measles occurred in the New York Foundling Asylum during the attendance of Drs. O'Dwyer and Lee. The number of children affected with it was 165, and, since many of them were cachectic, we were not surprised that gangrene appeared as a complication or sequel in 7 cases. In a girl of three and a half years it appeared upon the upper jaw at the base of the teeth; in two girls of four years it appeared upon the inside of the cheek and upon the vulva, and not upon the gums; in a boy of three years it attacked the lower jaw, destroying four teeth with their sockets, and the upper jaw, destroying five teeth, with the corresponding portion of the maxillary bone, so that all the incisors and one canine were lost, as well as the cartilaginous portion of the nasal septum. Gangrene also occurred in the groin in this case. Another boy of three and a half years lost two incisors from gangrene of the jaw. The treatment by muriatic acid was employed, and, according to the house physician, Dr. Kortright, there was no further extension of the gangrene after the first application in any of the cases. All lived except the first, who had broncho-pneumonia. The remaining two patients, aged respectively four years, died of diphtheria and pneumonia before treatment could be tested. One of them had commencing gangrene of the lower jaw, the other of the soft palate. Recently, in the Foundling Asylum carbolic acid has been used as an escharotic in one or two cases, instead of the strong acid, and with such a result as to encourage its further use.

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[1] *Diseases of Children*, 4th Amer. ed.

The gases arising from the gangrenous mass are not only highly offensive to others, but they are doubtless injurious to the patient, who is constantly inhaling them. To remove the fetor, chlorine or carbolic acid, properly diluted, should be occasionally used between the applications of the sulphate of copper. Labarraque's solution, one part to eight or ten parts of water, is an eligible form for its use. When the gangrene is removed and the granulations present a healthy appearance, all danger is usually past and convalescence is fully established. Then no energetic topical treatment is required. A mild stimulating lotion, like the tincture of myrrh, as recommended by Dr. Gerhard, suffices, with the aid of tonics and nutritious diet.

CHAPTER III.

DENTITION.

THE opinion formerly entertained in the profession, and now prevalent in the community, that many infantile maladies arise directly or indirectly from dentition is erroneous. Still, there are physicians of experience who believe that teething is a common cause of certain maladies, especially of functional derangements, even of organs remote from the mouth. On the other hand, equally good observers—and the number is increasing—almost wholly ignore the pathological results of dentition. They say that as it is strictly a physiological process it should, like other such processes, be excluded from the domain of pathology.

A moment's reflection will show how important it is to understand the exact relation of dentition to infantile diseases. Every physician is called now and then to cases of serious disease, inflammatory and non-inflammatory, which have been allowed to run on without treatment, in the belief that the symptoms were the result of dentition. I have known acute meningitis, pneumonia, and entero-colitis, even with medical attendance, to be overlooked, and the symptoms attributed to teething during the very time when appropriate treatment was most urgently demanded. Many lives are lost from neglected entero-colitis, the friends believing the diarrhœa to be symptomatic of dentition, a relief to it, and therefore not to be treated. Such mistakes are traceable to the erroneous doctrine, once inculcated in the schools, and still held by many of the laity, that dentition is directly or indirectly a common cause of infantile diseases and derangements.

I shall endeavor to point out what is really ascertained in regard to the pathological relations of dentition.

The first dentition commences at the age of about six months and terminates at the age of two and a half years. The corresponding teeth of the two sides pierce the gum at about the same time. The two inferior central incisors first appear at about the age of six or seven months, followed, in the order in which they are mentioned, by the upper central incisors, upper lateral incisors, lower lateral incisors, the four anterior molars, the four canines, and, lastly, the four posterior molars.

The incisors usually appear in rapid succession, so that all are in sight by the age of one year. From the age of one year to eighteen months the anterior molars appear, and from the age of sixteen to twenty-four months the canines, and from twenty-four to thirty months the posterior molars. This order is not always preserved. Sometimes the upper central incisors appear before the lower, and sometimes the lower lateral before the upper lateral. In rare cases there have been teeth at birth. I have seen but one or two infants with such premature dentition. Retarded dentition is much more common. Those who have rickets or are feeble either constitutionally or by disease often have no teeth till considerably after the usual period. In such the first incisors may not appear till the age of twelve months, or even later.

PATHOLOGICAL RESULTS OF DENTITION.—The evolution of the teeth is commonly attended by more or less turgescence around the dental bulbs. This is greater with some of the teeth than with others. Thus the superior incisors cause more swelling than do their congeners of the inferior jaw. The turgescence, although attended by more or less congestion, is physiological within certain limits, and not a disease.

But sometimes there is an unusual amount of swelling around the dental follicles; the afflux of blood to them is greatly augmented; they are the seat of such a degree of tenderness and pain that the infant is fretful. It carries the finger often to the mouth, indicating the seat of its suffering. The surface over the follicles presents greater redness than in ordinary dentition, and the salivary secretion is considerably increased. There is now actual gingivitis.

Occasionally the inflammation affects a greater extent of the buccal surface than that lying directly over the follicles, so that most writers speak of stomatitis as one of the results of dentition. In a few cases I have known such a degree of inflammation over the advancing tooth that a small abscess formed, producing much pain and restlessness till it was opened by the lancet.

The pathological results of dentition which I have mentioned, though they may interfere more or less with nursing or feeding, are not dangerous. They are easily detected. They result directly from the rapid growth and augmented sensitiveness of the dental follicles.

There are other supposed accidents of dentition occurring in distant parts of the system in consequence of the relation and interdependence of organs which exist through the system of nerves.

Some children previously to the eruption of the teeth are affected with diarrhœa, occasionally accompanied by irritability of stomach. Certain writers have supposed that gastro-intestinal catarrh is present in these cases; others that there is simply a hypersecretion, an increased activity of the intestinal follicular apparatus—that it is, in other words, one of the forms of non-inflammatory diarrhœa. Barrier believes that the diarrhœa of dentition depends usually on what he calls a "subinflammatory turgescence limited to the gastro-intestinal follicular apparatus." He believes that in occasional cases it is due to defective or altered innervation. It would then be analogous or similar to that form of diarrhœa which occurs in the adult from the emotions. Bouchut calls the diarrhœa of dentition nervous diarrhœa. It is certain, however, that in most cases of diarrhœa which are attributable to dentition there are other causes, such as unsuitable food or residence in an insalubrious locality. It is certain, as regards city infants, that the chief causes of diarrhœa during the period of dentition are strictly antihygienic, dentition being quite subordinate as a cause, and probably ordinarily not operating at all as such. But when, as sometimes happens, at each period of dental evolution the infant is affected with diarrhœa, the influence of teething is apparent. Such cases enable us to see that teething may really sustain a causal relation to certain diseases not located in the buccal cavity.

Among the more common pathological results of difficult dentition are certain affections referable to the cerebro-spinal system. Eclampsia is one of the admitted results. Barrier attributes convulsions in the teething infant to excitement of the nervous system arising from the pain which is felt in the gums, and to a determination of blood to the dental apparatus, in which afflux the whole vascular system of the head participates.

In most cases of convulsions occurring during the period of dental evolution a careful examination discloses other causes in addition to the state of the gums. Difficult dentition must then be considered not so frequently a direct as a co-operating or predisposing cause, producing a sensitive state of the nervous system, or possibly an afflux of blood to the head, of which Barrier speaks, and which by an additional stimulus, perhaps trivial in itself, ends in convulsions. In exceptional instances eclampsia occurs mainly from dentition, or if there are other causes they are quite subordinate. This may happen when several teeth penetrate the gum at or about the same time. Infants who are burned or scalded are very liable to clonic convulsions. This is, in fact, the chief danger as regards life from such accidents. So the swollen and tender gum, if several teeth are about emerging, may affect the cerebro-spinal system like the burn or scald and produce the same nervous phenomena. Thus in a case already alluded to in the chapter on Convulsions, five incisors pierced the gum within about two weeks, and in this period there were two attacks of eclampsia with an interval of a few days. The attacks were not severe, and the most careful examination could discover no other cause than the simultaneous development of so many dental follicles. Previously and since the infant has been well.

Dentition sometimes, though rarely, occasions also tonic contraction of certain muscles. The following case occurred in the practice of the late Dr. A. S. Church of this city, the history of which he communicated, as follows:

Case.—"H——, seven months old, was first visited April 3, 1863. The patient had been fretful for several days, but about daylight on the morning of my first visit it commenced crying, and had not ceased for a moment at the time of my visit, 9 A. M. The bowels were somewhat constipated and tympanitic; abdominal muscles very tense. The pain was supposed to be in the abdomen, and a brisk cathartic, to be followed by an anodyne, was ordered. Some relief followed, but on the ensuing and for several consecutive mornings the pain returned, each day lasting longer, until the child only ceased crying while under the influence of a full anodyne. The gum over the upper incisors was considerably swollen, hot, and dry, but the parents would not consent to have it scarified. For the first week there was no fever, no vomiting, and not the least indication that the nervous system was suffering. About the 10th the thumbs were noticed to be flexed during the attack of pain, and about the 15th the flexors of the toes were contracted and the hands were turned backward and outward, but only while the child was awake. About the 20th there was constant contraction of the flexors of both extremities, with opisthotonos, and constant rolling of the head, loss of appetite, progressive emaciation, coated tongue, and highly-inflamed gums. Consent was finally obtained to relieve the inflamed gum, and free incisions were made, and the following night the child slept comfortably for three hours without opiates. In three days the gums were freely cut again, and the teeth soon made their appearance. All symptoms of disease had now ceased, the child became playful, and on the 30th the patient was discharged."

More recently a child of about eighteen months, seen by me in consultation, had tonic contraction of the flexors of the left thigh and leg, continuing nearly a month, so that the thigh was flexed on the body and the leg on the thigh. The infant was cutting five teeth at the time, and the gums were considerably swollen over them. The normal state of the affected limb was not restored until these teeth had penetrated the gum.

The opinion has been prevalent in the profession that painful and difficult dentition is one of the chief causes of infantile paralysis, but it is now commonly admitted that it is only a subordinate or remote cause, if indeed it is proper to consider it as a cause at all. (See art. Paralysis.)

Some writers express the opinion that acute meningitis occasionally results from teething. The facts, however, that are relied upon to prove this are uncertain. The occurrence of meningitis during dentition is probably in most instances a coincidence.

Teething less frequently disturbs the respiratory system than either the digestive or cerebro-spinal. A cough occurs in some infants at each period of dental evolution. It is attended by little expectoration, but appears to be associated with, in at least certain cases, an inflammatory turgescence of the bronchial mucous membrane.

Acceleration of pulse is often observed at the time of greatest swelling and tenderness of the gum. It subsides with the protrusion of the tooth. The fever of dentition is irregular, sometimes presenting a remittent form, like remittent fever or the fever premonitory of meningitis. Eczema and certain other cutaneous diseases are common during dentition, but their dependence on it as a cause has not been demonstrated.

Diagnosis.—The accidents of dentition which are located in the mouth are easily diagnosticated, except the odontalgia which writers describe, and which is not necessarily attended by any perceptible anatomical alteration of the gums. Those accidents which pertain to remote and concealed organs are usually detected with ease, though it is often difficult to determine with certainty their relation to dentition.

When similar symptoms arise at each epoch of teething and subside with the subsidence of the gingival turgescence, teething must be regarded as the cause. Or, if the disease be such as is known to be produced occasionally by difficult teething, and if, after a careful examination, we can discover no other cause, while the gums are swollen, especially over two or more advancing teeth, it is proper to refer the malady to dentition.

It is evident that we must often be in doubt whether the disease we are treating be due at all to the state of the gums, or, if so, whether directly or indirectly or to what extent; but as a rule if any other cause be apparent we may properly regard the influence of dentition as quite subordinate.

Treatment.—It is obvious that remedial measures in cases of difficult dentition must be twofold—namely, those directed to the state of the gums, and those designed to relieve the derangements or diseases to which dentition has given rise. If there be diarrhœa, this should be controlled by proper remedies, so as to reduce the number of evacuations to two or three daily. It is well to state to the friends of the child who believe that diarrhœa is salutary during the period of teething that this number is quite sufficient, and that more frequent evacuations endanger the safety of the child.

The nervous affections, as convulsions, require such soothing and derivative measures as are recommended in our remarks on Diseases of the Nervous System. The bromide of potassium I have found especially useful and safe in cases of fretfulness and nervous excitement due to dentition. Demulcent and soothing lotions are sometimes useful in cases of painful dentition, and the infant may be allowed to hold in its mouth an India-rubber or ivory ring, which seems to give considerable relief.

Mothers often attempt to "rub through a tooth," as they term it, by means of a ring or thimble. This should be discouraged. So great friction cannot fail to have an injurious effect by increasing the swelling and inflammation, unless the tooth have already reached the mucous membrane.

We come now to a subject which has engaged the attention of many physicians of ample experience, and in reference to which there is still a difference of opinion among the highest authorities in medicine. I refer to scarification of the gums.

The gum-lancet is much less frequently employed than formerly. It is used more by the ignorant practitioner, who is deficient in the ability to diagnosticate obscure diseases, than by one of intelligence, who can discern more clearly the true pathological state. Its use is more frequent in some countries, as England, under the teaching of great names, than in others, as France, where the highest authorities, as Rilliet and Barthez, discountenance it.

It is well to bear in mind, as aiding in the elucidation of this subject, the remark made by Trousseau, that the tooth is not released by lancing the gum over the advancing crown. The gum is not rendered tense by pressure of the tooth, as many seem to think, for if so the incision would not remain linear, and the edges of the wound would not unite, as they ordinarily do by first intention within a day or two. This speedy healing of the incision unless the tooth be on the point of protruding is an important fact, for it shows that the effect of the scarification can last only one or two days. The early repair of the dental follicle is probably conservative, so far as the development of the tooth is concerned. It may help us to understand how active, how powerful, the process of absorption is, if we reflect that the roots of the deciduous teeth are more or less absorbed by the advancing second set, without much pain or suffering from the pressure. If the calcareous particles of the teeth are so readily absorbed, what is the foundation for the belief that the fleshy substance of the gum is absorbed with such difficulty? Too much importance has evidently been attached to the supposed tension and resistance of the gum in the process of dentition.

Follicles in the period of development are especially liable to inflammation. We see this in the follicular stomatitis and enteritis so common when the buccal and intestinal follicles are in a state of most rapid growth. Does not this law in reference to the follicles hold true of those by which the teeth are formed, so that the period of their enlargement and greatest activity, which corresponds with the growth and protrusion of the teeth, is also the period when they are most liable to congestion and inflammation? It seems probable that the dental follicles are most liable to become inflamed, and therefore tender, from various causes apart from dentition at the time of their greatest functional activity.

If there be no symptoms except such as occur directly from the swelling and congestion of the gum, the lancet should seldom be used. The pathological state of the gum which would, without doubt, require its use is an abscess over the tooth. As to the symptoms which are general or referable to other organs, as fever and diarrhœa, the lancet should not be used if the symptoms can be controlled by other safe measures. All co-operating causes should first be removed, when in a large proportion of cases the patient will experience such relief that scarification can be deferred.

If the state of the infant be one of immediate danger, as in eclampsia, and it be not quickly relieved by the ordinary remedies, scarification may not only be proper, but required to ensure safety. For in such cases all measures, provided that they are safe and simple, which can possibly give relief, should be employed without delay. But I can recall to mind only three accidents of dentition which would be likely to be benefited by scarification—namely, suppurative inflammation in the dental follicle, extreme fretfulness continuing day after day, and convulsions. But since the bromide of potassium and hydrate of chloral have come into use as nervous sedatives and as efficient remedies for clonic convulsions, scarification of the gums is much less frequently required, for even severe eclampsia commonly yields to these medicines if the condition of the bowels be attended to. In some instances I have found that the elixir anisi (aniseed cordial) of the National Formulary, containing as it does anethol and the oils of fennel and bitter almonds, administered in doses of ten drops to an infant of one year, is apparently more quieting in cases of restlessness than the bromide. It may be given with the bromide.

SECOND DENTITION.

The fact is well established, though often overlooked in practice, that second dentition occasionally deranges the functions of organs and gives rise to pathological symptoms. Rilliet and Barthez mention particularly neuralgic pains, rebellious cough, and diarrhœa as effects which they have observed. Rilliet relates the case of a girl eleven years old who had a very obstinate and protracted cough, the paroxysms lasting often half an hour to one hour. This cough immediately and permanently disappeared when the molars pierced the gums.

Dr. James Jackson[1] says: "I have seen persons between twenty and thirty years of age much affected by a *wisdom tooth* not yet protruded, and distinctly relieved by cutting the gum. But I think the most common period of suffering from the second dentition is from the tenth to the thirteenth year. The most characteristic affections are wasting of flesh and nervous diseases. The boy loses his comeliness and his complexion is less clear, while emaciation takes place in every part, though mostly perhaps in the face. The nervous symptoms are various, but the most common are a change in the temper and a loss of spirits. With these there is some loss of strength. The patient is unwilling to engage in play, and soon becomes tired when he does do it. Among the distinct symptoms which are not uncommon I may mention pain in the head and in the eyes. The headache is not commonly severe, but it is such as inclines the patient to keep still. The eyes are not only painful, but are often affected with the morbid sensibility to which these organs are subject. I have known boys truly anxious to pursue their studies obliged to give them up on this account; and these, not having the disposition to play, will of choice pass the day with their mothers and increase their troubles for the want of air and exercise. Nervous affections of a more severe character are sometimes manifested."

Whether the symptoms which have been attributed to second dentition have always been due to this cause is questionable. Practically, however, it matters little whether we recognize dentition as the cause or assign something else. Hygienic and medicinal measures to improve the general health will usually suffice to relieve the patient. Elsewhere I have related the case of a boy of nervous temperament, about seven years old, who recovered immediately from a cough which had lasted for several weeks by taking a mixture of iron and nitric acid. Many do well without medicine, simply by hygienic measures. Dr. Jackson says: "The remedies which I have found most useful are as follows: First, a relief from study or from regular tasks, yet using books so far as they afford agreeable occupation or amusement. Second, exercise in the open air, preferring the mode most agreeable to the patient, and in more grave cases the removal from town to country."

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[1] *Letters to a Young Physician.*

CHAPTER IV.

CATARRHAL PHARYNGITIS, PERIPHARYNGEAL ABSCESS, ŒSOPHAGITIS.

CATARRHAL PHARYNGITIS.

CHILDREN of all ages are liable to inflammation of the pharynx. In its mildest form it often, doubtless, escapes detection in the young infant. In older patients it is revealed by pain in swallowing solid food and more or less tumefaction below the ears, apparent to the sight. It is said to be less frequent in infancy than in childhood. In the adult and in children over the age of four or five years inflammation of the pharyngeal surface is often confined to the portion of membrane which covers or immediately surrounds the tonsils. It occurs in connection with inflammation of these glands. But in infancy and early childhood this limitation is comparatively rare. Catarrhal inflammation of the fauces at this age is ordinarily general, the tonsils participating in the morbid state.

Pharyngitis is primary or secondary. The secondary form occurs in measles, scarlet fever, bronchitis, croup, pneumonia, and occasionally in other affections. As these diseases are common, physicians are oftener called to treat patients who have the secondary form than the primary. Rilliet and Barthez met 83 secondary to 16 primary cases.

ANATOMICAL CHARACTERS.—The pathological anatomy of pharyngitis is ascertained by depressing the tongue and inspecting the fauces. The faucial surface is seen to be redder than in health, with more or less swelling according to the intensity of the inflammation. In the primary inflammation the color is commonly bright red, almost like that of arterial blood. If, on the other hand, the inflammation occur in connection with a constitutional malady, the hue is often darker. In grave cases of scarlet fever or measles it is sometimes even livid, indicating a vitiated state of the blood—a condition of real danger. The tonsils are tumefied so as to project, though not to the extent which we observe in the adult. They are less firm than in the normal state. The follicles of the throat are enlarged and active, pouring out a muco-purulent secretion. This is sometimes seen in a layer over the tonsil or the posterior portion of the fauces. In a case of primary pharyngitis examined after death by Rilliet and Barthez the tonsils were softened, infiltrated with pus, and slightly enlarged. A layer of bloody mucus lay on the pharyngeal surface, which was dark red and thickened. The submaxillary glands were also swollen and somewhat softened.

If the inflammation be intense the deep-seated portions of the tonsils become involved, and even sometimes the adjacent connective tissue. In such cases by applying the fingers in the hollows below the ears the tonsils can be felt.

CAUSES.—The usual cause of primary pharyngitis is exposure to cold. It also occasionally occurs from the use of drinks too hot or containing some irritating substance. I have met it in the most intense form caused by swallowing boiling water, and in one case from acetic acid taken through mistake. When it occurs in the eruptive fevers it is usually part of a more extensive phlegmasia in which the buccal and perhaps laryngeal and nasal surfaces participate.

Symptoms.—Fever, with thirst and loss of appetite, is common, and is usually proportionate in intensity to the extent and severity of the inflammation. At first there is dryness of the faucial surface, and this is succeeded by a more or less abundant viscid secretion. Swallowing is painful, except in mild cases. The muscles of the anterior half arches, which by their contraction close the opening from the pharyngeal to the buccal cavity, and those of the posterior arches, which close the opening to the nasal cavity, both which sets lie a little under the mucous membrane, are often so infiltrated with serum that their contractile power is diminished, and if the same happen with the constrictor muscles, which carry downward the food, swallowing becomes difficult, and in the attempt more or less of the ingesta is liable to return into the mouth or enter the nostril. During health the air passes through the nostrils in the pronunciation of two letters only—namely, *n* and *m*—but in severe pharyngitis, in consequence of the swelling and the impairment of the action of the muscles concerned in speech, the air passes through the nostrils with the utterance of many words, producing the nasal tone of voice. Sometimes the inflammation traverses the Eustachian tube to the middle ear, causing earache, which may be relieved by the escape of pus down the tube or by perforation of the drum into the external ear.

The breath is foul, but not fetid; the respiration normal or but slightly accelerated; there is commonly no cough, but it is sometimes present, due to the extension of the inflammation to the upper part of the larynx or to the collection of mucus around the aperture of the glottis. In most cases of pharyngitis a light fur covers the tongue, and stomatitis of a mild grade is present, as shown by redness of the buccal surface and increased mucous secretion.

Chronic pharyngitis, which is so common in adults, and which is produced in some by gastric derangements, and in others by excessive smoking or the prolonged use of intoxicating drinks, and in others still by the syphilitic or mercurial cachexia, is comparatively rare in children.

Prognosis.—In mild cases of pharyngitis convalescence commences within a week. If the inflammation be dependent on a constitutional malady, it may continue considerably longer, especially if the glands of the neck and the connective tissue be much involved. The prognosis in secondary pharyngitis is less favorable than in that of the primary form. In fatal cases there is usually a vitiated state of the blood, either from the coexisting constitutional disease or from previous cachexia.

Pharyngitis may, however, become dangerous from complications to which it gives rise. The proximity of the inflammation to the brain or its effect upon the cerebro-spinal axis through the medium of the nerves sometimes gives rise to clonic convulsions. In a recent case of primary pharyngitis in my practice repeated and violent convulsions occured in an infant about one year old from this cause. They commenced at the inception of the inflammation, and constituted the only real danger. Pharyngitis may interfere materially with nutrition in consequence of the dysphagia, but in most cases of primary pharyngitis this symptom does not continue sufficiently long to endanger the life of the patient. In grave constitutional affections, as scarlet fever, the difficulty of swallowing and the consequent innutrition augment the danger. As regards, therefore, the prognosis in catarrhal pharyngitis, whether primary or secondary, it may be stated as a rule that it is not, *per se*, a fatal disease, but is only so from complications or from aggravating the primary malady with which it is associated.

Diagnosis.—This is not difficult, provided that attention be directed to the throat; but the physician often fails to discover it at his first visit from neglecting to examine this part. In many cases the local symptoms are not well marked, and in the absence of these the febrile reaction may at first be referred to some other cause than the true one. Inspection not only reveals the presence of inflammation, but enables us to determine whether it be simple pharyngitis or diphtheritic or ulcerative. In some instances simple pharyngitis resembles the diphtheritic, from the presence of confervoid growths upon the inflamed surface, usually the Leptothrix buccalis. The differential diagnosis is based on the easy removal and soft pultaceous character of the confervæ and the appearance under the microscrope.

TREATMENT.—*Mild* cases of simple pharyngitis require little treatment. With moderate counter-irritation over the throat and the use of laxative medicines the inflammation soon subsides. The oleum camphoratum may be occasionally rubbed over the throat and retained upon it by flannel. The effect is increased by the application, once or twice daily, of mustard or tincture of iodine, or by adding to the liniment one-fourth or one-third of its quantity of turpentine.

Some children seem to be most relieved by a muslin compress frequently wrung out of cool water or a light India-rubber bag containing ice. Frequently rubbing the neck with warm oil or camphorated oil and binding upon it a rind of salt bacon are popular modes of treatment, and no doubt are productive of benefit.

In the severe forms of this inflammation, occurring independently of any other disease, more active measures are sometimes required.

If there be stupor or restlessness, with unusual heat of head, and starting or twitching of the limbs which threatens convulsions, two to five grains of the bromide of potassium given every two or three hours produce a calmative effect.

Diaphoretic and sometimes cardiac sedatives are also indicated, such as liquor ammoniæ acetatis, spiritus ætheris nitrosi, ipecacuanha, and aconite. Medicines of this kind may be variously combined according to the age and condition of the patient and the severity of the disease.

As the symptoms abate the intervals between the doses may be increased.

In cases attended by much tenderness and dysphagia great relief is often obtained by hot poultices frequently applied over the neck.

Topical treatment of the pharynx is recommended by most authors. Rilliet and Barthez use for this purpose nitrate of silver or powdered alum. The former has been most employed by physicians. It may be applied in the proportion of ten grains to the ounce two or three times daily. I prefer the following mixture, used with the hand-atomizer every hour to two hours:

℞. Cocaini muriat., gr. x;
Glyceriti acidi tannici, ʒj;
Sodii biborat., ʒj;
Ammon. chloridi, ʒj;
Glycerinæ, ℥j;
Aquæ, ℥v. Misce.

This can of course be used as a gargle by those old enough, or more continuously by the steam-atomizer.

The treatment of secondary pharyngitis will be described in connection with the treatment of the diseases which it complicates. Suffice it here to say that this form of inflammation must not be treated by those depressing remedies which may be useful in cases of idiopathic pharyngitis.

PERIPHARYNGEAL ABSCESS.

Every practitioner should bear in mind the fact that an abscess occasionally forms between the pharynx and vertebral column (retropharyngeal) or upon the side of the pharynx in the submucous connective tissue. This constitutes a disease which is likely to be fatal, but which can ordinarily be promptly relieved by the surgeon.

Yet if we look over the records of peripharyngeal abscess we shall see that in a large proportion of fatal cases the disease was supposed to be something else, and so treated until its nature was revealed by post-mortem examination. The most complete monograph on this malady with which I am acquainted was published by Dr. Allen[1] of this city, under the title of "Retropharyngeal Abscess." To this paper I am largely indebted for the facts contained in this article.

AGE; CAUSES.—This abscess may occur at any age, but it is most common in infancy and childhood. It is more frequent in the first two years of life than at any other period. Of the cases collated by Dr. Allen in which the age is stated, 20 were under ten years and 21 over this age. The abscess occurs in some patients from caries of the vertebral column, and in others from inflammation developed in the connective tissue or small lymphatic glands lying immediately outside the pharynx, or from a catarrhal pharyngitis. Whichever the cause, there is usually a scrofulous or reduced state of system.

Writers describe two kinds of peripharyngeal abscess, the primary and secondary. This distinction is based on the fact whether or not the inflammation which leads to the abscess be dependent on an antecedent pathological state.

In the primary form the cause is usually atmospheric, or it is some irritating substance which has been swallowed, and which, lodging in the pharynx, produces phlegmonous pharyngitis.

The cause is mentioned in 20 cases of the primary form, collated by Dr. Allen, as follows: exposure to cold, 10 cases; lodgment of bone in pharynx, 8 cases; blow with a fencing-foil, 1 case. In the last case the button of a fencing-foil passed through the right nostril into the pharynx.

The secondary form occasionally occurs after measles and scarlet fever. The inflammation of the pharynx common in those diseases extends to the subjacent connective tissue, and, aided by the dyscrasia of the patient, becomes suppurative. Such cases have been observed by Rilliet and Barthez. The most common cause of the secondary form is, however, caries occurring in the cervical vertebræ.

When thus occurring it is similar, both as regards cause and nature, to lumbar abscess. It would follow the same chronic course, and would properly be described in connection with it, were it not for its proximity to the air-passages, which renders the symptoms so urgent and dangerous. In a few recorded cases the abscess was a sequel of erysipelas. In 19 cases of secondary abscess in Dr. Allen's collection the cause is assigned as follows: erysipelas of face, 2; inflammation following a fall upon the inferior maxilla, 1; after cerebritis, 1; syphilis, 4; caries of the cervical vertebræ, 6; scrofula, 5.

The plausible opinion is expressed by Mr. Fleming[2] that the suppuration begins in a large proportion of cases in the small lymphatic glands which lie in the connective tissue external to the pharynx. The late Prof. George T. Elliot[3] has recorded the case of an infant of seven months in whom peripharyngeal abscess immediately followed and was apparently due to parotiditis.

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[1] *N. Y. Jour. of Med.*, for November, 1851.

[2] *Dublin Jour. of Med. Sci.*, vol. xviii.

[3] *Obstet. Clinic N. Y.*

In rare instances the abscess, or the local disease which leads to it, appears to exist from birth. Thus Dr. E. O. Hocken relates[1] the history of an infant which died at the age of nine weeks. It had always, when taking the breast, thrown back its head as if nearly suffocated. The walls of the abscess were thick and firm, described by the writer as cartilaginous. Occasionally there is no apparent cause of the abscess except the strumous or cachectic state.

ANATOMICAL CHARACTERS.—The seat of the abscess is not the same in all cases. The swelling can ordinarily be seen on examining the fauces, but occasionally it is so low as to be really periœsophageal, and therefore invisible. The size of the abscess varies: sometimes it is large, pressing inward the wall of the pharynx even against the velum palati and into the posterior nares, if the abscess have a high location, or if lower against the larynx, so as to embarrass respiration. Sometimes the abscess is so large or has such lateral extension that there is external swelling along the side of the neck. In a few cases on record the pus, instead of being discharged into the pharynx, made its way down the neck between the muscles and the connective tissue to the pleural cavity, which it entered, producing fatal pleuritis.

The walls of the abscess have been found in a different state in different cases. Sometimes the sac at the projecting point is so thin that it seems as if there might have been a spontaneous cure could life have been preserved a few hours longer. In other cases the sac is so thick and firm that its rupture for many days would be impossible.

SYMPTOMS.—The precursory symptoms differ in different cases according to the nature of the cause, whether it be phlegmonous pharyngitis or simply adenitis or vertebral caries. If the abscess proceed from caries, it is preceded by deep-seated pain, greatly increased by movements of the head, and probably preceded also by induration along the sides of the vertebræ.

The patient with this disease is restless, his mouth hot and dry, tongue furred, deglutition more or less difficult. Sometimes after suppuration has occurred there are alternations of rigors and fever. The symptoms indicate approximately the seat of the inflammation, but on examination we do not find that degree of redness of the mucous surface which we had been led to expect. The tissues which are chiefly involved in the inflammation, being submucous, are hidden from view. We observe redness of the pharynx, but it is disproportionate to the intensity of the symptoms. Some patients frequently experience a chilly sensation through the entire period of the abscess, though greater at one time than at another, and occasionally convulsions occur, especially in young infants. In ordinary cases embarrassment of respiration begins early, and is the cause of the chief danger. It becomes more and more marked as the abscess increases. It is noticed both during inspiration and expiration. The dysphagia also increases, sometimes to such a degree that drinks are taken with difficulty and solid food refused. The respiratory symptoms bear considerable resemblance to those in protracted laryngitis, for which this disease has been mistaken. While the respiration becomes impeded or whistling, the voice is also feeble or indistinct from the pressure of the tumor.

But the symptoms described above are not all present in every case. y vary according to the size and location of the abscess, whether it be or low, posterior or lateral. I have met the disease in a child old enough ake known the subjective symptoms, in whom there was little or no dys- ; and others report similar cases. When the tumor has attained such at it produces well-marked symptoms and jeopardizes the life of the r a part of it can ordinarily be seen on depressing the tongue, but usually its location and condition can be better ascertained by exploration with the finger. The dyspnœa increases as the abscess enlarges, and after a time, unless it burst spontaneously or be opened by the surgeon, imperfect oxygenation of the blood results. In some patients paroxysms of dyspnœa occur, so as to threaten immediate suffocation; coughing or attempts to swallow induce these paroxysms, and the patient is forced to remain in an erect or semi-erect posture; the tongue is protruded, the head thrown back, the pulse is frequent and rapid, the limbs become livid and cool, and finally death results from dyspnœa. Occasionally, when death seems inevitable, the abscess breaks during the struggles of the child and the patient is restored to health. In rare cases the result is different. The trachea and bronchial tubes are deluged by the purulent discharge and immediate suffocation occurs. The following was an example: In May, 1871, a boy two years and five months old, who had the symptoms of an abscess for three months, was brought to the class at Bellevue. The head was carried on one side, its rotation caused pain, and a laryngeal râle accompanied respiration. The upper part of the tumor could be detected by the finger, but on account of its low location it was impossible to open it with the bistoury. The temperature was 103°, pulse 156. The case remained under observation, but in a few days the dyspnœa suddenly became so urgent that death was imminent, when the attending physician of the class, Dr. Swezey, broke the abscess with his finger and pus was ejected on the floor; death, however, occurred almost immediately.

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[1] *Prov. Med. and Surg. Jour.*, 1842.

A correct appreciation of the symptoms and nature of peripharyngeal abscess will be best obtained by relating a case. I select the following from the *Trans. of the Lond. Pathol. Soc.*, Oct. 20, 1846: A female infant died at the age of seven months, having had difficult breathing three weeks and extreme dyspnœa during the last days of life. The dyspnœa was constant, and was aggravated by mental excitement, by movements of the body, and by exposure to cold, During the paroxysms a peculiar croupy sound accompanied inspiration. There was no dysphagia through the entire sickness, and death occurred from apnœa. The sac of the abscess was of the size of a pigeon's egg, and was situated between the upper cervical vertebræ and the back of the pharynx. The abscess was flattened in front, so as not to cause any decided prominence of the wall of the pharynx. From the sac a second small cyst extended forward, forming a nipple-like swelling in the pharynx which completely closed the orifice of the glottis. Its aperture of communication with the body of the abscess admitted the point of the little finger, and the whole swelling was freely movable and perfectly translucent at its extremities and sides. The abscess might have been easily punctured, with probably the preservation of life.

The DURATION of this malady is very different, according to the inflammation, the rapidity with which the abscess enlarges, and the direction which it points. A lateral or downward extension is not so immediately dangerous to life as the anterior.

The time when the abscess begins to form cannot be precisely ascertained, and most writers in determining its duration compute from the first appearance of symptoms which are referable to the pharynx. Dr. J. Byrne[1] relates a fatal case in which the disease had apparently continued only about one week. The patient was an infant one year old, and its death was from apnœa. The abscess was large, extending from the base of the skull to the thorax and pressing both on the larynx and trachea. M. Besserer[2] gives the history of an infant four months old who died in the same way after thirteen days. An infant nine months old, whose case was published by Dr.

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[1] *Amer. Jour. of Med. Sci.*, 1838.

[2] *Archiv. gen. de. Méd.*, 1840.

W. C. Worthington,[1] lived nine days. The abscess occurred from exposure to cold; the patient was treated for croup and died from suffocation. The anterior wall of the abscess was very thin. In two cases treated by me the symptoms indicated a continuance of the disease from two to four weeks, and in a third case four months. A fourth case is interesting on account of the short duration of the severe symptoms. The following is the record of it: M. E——, aged seven months, female, nursing, inmate of the New York Foundling Asylum, was observed to have difficult breathing for the first time on March 28, 1875. Since about March 8th some swelling had been noticed along the side of the neck, but it gave rise to no marked symptoms, and she had not seemed ill till the obstruction in the respiration commenced. At my visit on the evening of the 28th the infant was pointed out to me as in a dying condition. She was lying in a state of stupor, pallid and gasping for breath, with a temperature of 103°, and very feeble pulse, numbering about 200 per minute. On carrying the finger into the throat an abscess could be readily detected, situated in the walls of the pharynx on the left side posteriorly. This was easily opened by a curved bistoury, around which adhesive plaster was wound to within half an inch of the point. The breathing immediately began to improve. On the following day the infant was playing in the mother's lap, with a pulse of 140, but a normal temperature. With the use of cod-liver oil and the syrup of the iodide of iron its health was soon fully restored. In a fifth case the abscess was ruptured by the finger, and in a sixth it was opened by the lancet. All these patients recovered.

When the abscess grows slowly and presses lightly on the air-passages the case may continue for months. Such a one was observed by the late Professor Willard Parker (Allin). This infant was one year old; it suffered from pharyngeal symptoms nine months, was treated for tonsillitis, and death occurred as usual from apnœa. The abscess was two inches long, and there was no disease of the vertebræ. The same surgeon saved the life of another patient four years old, in whom the disease was protracted, by puncturing the abscess; and the late Professor Post also treated successfully a case which had continued three months (Allin).

DIAGNOSIS.—The diagnosis of retropharyngeal abscess is ordinarily easy, provided that the physician examine carefully and bear in mind the occasional occurrence of such an abscess. In a large proportion, however, of the recorded fatal cases the true nature of the disease was not recognized during life. Especially is the diagnosis difficult when the cerebro-spinal system is early implicated and symptoms arise which divert attention from the throat to the brain.

The maladies for which peripharyngeal abscess is most frequently mistaken are laryngitis and simple but severe pharyngitis. From laryngitis, for which it has been most frequently mistaken, it may be distinguished by the dysphagia and by the character of the initial symptoms. In laryngitis there is usually the peculiar cough from the first or very early, while in abscess there is an initial period of several days, or even weeks, before respiration is materially affected. This is the period of inflammation which precedes suppuration.

In abscess pressure of the larynx backward is badly tolerated, greatly increasing the dyspnœa, while in pharyngitis and croup this effect is not so marked. In abscess the horizontal position aggravates the dyspnœa, but not in pharyngitis and croup. The character of the voice also aids in diagnosticating an abscess from laryngitis, since in the former it is usually nasal, and in the latter hoarse and whispering. But the decisive test is afforded by inspection and digital exploration. The tumor is seen—or, if situated too low to be seen, is felt—upon the walls of the pharynx.

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[1] *Prov. Med. and Surg. Jour.*, 1842.

If the symptoms of abscess are masked by those arising from the cerebro-spinal system, as by convulsions, the priority of the pharyngeal symptoms aids in determining the true disease.

In a case of suspected abscess the physician should not only carefully inspect the fauces, but should also employ digital examination. The finger will often detect fluctuation before the abscess is apparent to the eye.

PROGNOSIS.—With proper treatment the result is usually favorable, but if the disease be not recognized many die. In Dr. Allin's cases, of those under the age of twelve years, 9 died, while 10 recovered by the opening of the abscess by the lancet, trocar, or finger, and 1 by its spontaneous rupture.

If the abscess be due to disease of the spinal column, death may occur immediately after the sac is opened, the caries of the intervertebral cartilages producing, according to Dr. Allin, dislocation of the vertebræ. Death may also occur, though rarely, from pleuritis, in consequence of the bursting of the abscess into the pleural cavity. Even in caries, if the sac be properly opened and if need be reopened, and the head supported by suitable apparatus, recovery is possible, as in a case treated by Prof. Post.

TREATMENT.—The proper treatment of peripharyngeal abscess is simple, consisting in breaking or puncturing the sac by the finger, the lancet, bistoury, or pharyngotome. Each method has been successfully employed. In the majority of cases the proper way to open the abscess is by the ordinary curved scalpel or bistoury, which should be covered by a strip of adhesive plaster to within half an inch of the point. If the abscess be postpharyngeal it should be opened in the median line. A single incision suffices to evacuate the pus. If the abscess point or be elastic, there is little danger of wounding any important vessel or producing dangerous hemorrhage if the operation be properly performed. It may be necessary to open the abscess more than once, as in a case reported by Dr. Post and another which I saw with Dr. Livingston of this city. In certain cases, when the knife cannot be readily employed, the abscess may be opened by pressure with the finger-nail or the edge of a teaspoon.

Patients with this disease ordinarily require constitutional treatment, especially the use of tonics, ferruginous and vegetable. The citrate of iron and quinine, the citrate of iron and ammonium, and in strumous cases the syrup of the iodide of iron with cod-liver oil, are eligible preparations. Nutritious diet and often alcoholic stimulants are required.

ŒSOPHAGITIS.

Disease of the œsophagus in infancy and childhood is comparatively rare, inflammation being the most frequent affection of this portion of the digestive tube in these periods, and, indeed, the only one which claims attention. It is most common in infants under the age of three or four months who are deprived of the breast-milk and are given a diet which is with difficulty digested, and perhaps taken too hot or too cold. It is therefore most common in foundling hospitals. I have frequently observed it in the Infants' Hospital and the Nursery and Child's Hospital of this city, chiefly at the autopsies of bottle-fed infants under the age of six months, whose symptoms had indicated disease or derangement of the digestive function. Many of them had diarrhœa and died in a state of emaciation. Œsophagitis in these cases was associated with simple or gangrenous stomatitis, thrush, or with gastritis or entero-colitis. Sometimes all these inflammations coexisted. In a few cases the confervoid growth of thrush had extended from the mouth to the œsophagus. It occurred in small hemispherical masses scarcely as large as a pin's head. Swallowing corrosive or strongly irritating substances, as the acids or alkalies, is an occasional cause of œsophagitis, the irritant at the same time producing stomatitis and gastritis.

ANATOMICAL CHARACTERS.—The inflamed surface sometimes presents a uniformly injected appearance. Usually, however, there is greater intensity of the inflammation in streaks or patches than over the surface generally. I have frequently observed at autopsies a greater degree of inflammation in the lower than upper half of the œsophagus, even when the infant had stomatitis at the time of death.

Œsophagitis occurring from faulty regimen or antihygienic conditions is not accompanied by as much thickening of the walls of the tube as often occurs in some other portions of the digestive canal; as, for example, in the colon. Diphtheritic inflammation of the œsophagus is accompanied by so great infiltration of the mucous membrane and underlying connective tissue that I have seen the œsophageal walls three or four times the normal thickness.

Occasionally ulcerations of the œsophageal mucous membrane are observed in the lower part of the tube, and Billard describes the ulcerative form of œsophagitis. At the first autopsies at which I observed these ulcers I supposed that they were pathological and indicated a severe grade of inflammation; but a more extended observation has convinced me that they are usually post-mortem, and are not at all dependent on inflammation of the œsophagus. The solvent power of the gastric juice not only causes ulceration in the stomach, but, entering the œsophagus, may and not infrequently does produce a solvent action on the mucous tissue there in the cadaver. At the meeting of the London Pathological Society, March 4, 1852, Dr. Graily Hewitt presented a specimen in which the gastric juice had not only eaten entirely through the coats of the œsophagus an inch above the stomach, but had even attacked the left lung. Over the age of six months inflammation of the œsophagus is rare.

The symptoms of œsophagitis in young and emaciated infants, in whom it ordinarily occurs, are not well pronounced. Pain in deglutition or tenderness on pressure over the œsophagus, if present in these infants, is ordinarily not appreciable, nor have they seemed to me to vomit oftener than other infants of this class who suffered from indigestion and gastro-enteritis without œsophagitis. It is therefore difficult to diagnosticate œsophagitis in them. It is, according to my observation, oftener present than absent in spoon-fed infants of three months or under who have persistent stomatitis and entero-colitis.

TREATMENT.—In the œsophagitis of foundlings and ill-nourished infants, which arises, as has been stated, from faulty regimen, no treatment is required apart from that designed to relieve the stomatitis or entero-colitis with which it occurs. Attention must be directed mainly to the diet and hygienic management. The remedial measures proper for such patients are more fully detailed in our remarks on entero-colitis. Œsophagitis produced by swallowing corrosive or highly irritating substances requires the same treatment as in the adult—to wit, poultices, demulcent drinks, etc.

CHAPTER V.

INDIGESTION, CONGESTION OF STOMACH, GASTRITIS, FOLLICULAR GASTRITIS, DIPHTHERITIC GASTRITIS, GASTRO-MALACIA.

INDIGESTION.

INDIGESTION is more common during infancy than in any other period of life. While the digestive organs in the adult readily assimilate a great variety of food, it is necessary for the well-being of the infant that its diet be simple and carefully prepared. Departure from this rule leads to indigestion and ulterior diseases.

After the age of two years a mixed diet is readily assimilated, the digestive function is less frequently disordered, and indigestion presents few peculiarities to distinguish it from that of the adult.

Indigestion in some children is habitual; in others the digestive process is ordinarily well performed, but from some temporary derangement of system or error of diet an acute attack of indigestion occurs. Hence, two forms of this ailment may be described; first, acute, referring to temporary attacks; secondly, chronic, referring to the habitual state.

CAUSES.—The causes of indigestion are twofold: first, the condition of the digestive function independently of the aliment; secondly, the unwholesome or improper character of the ingesta. Anything which lowers the vital powers may be a predisposing cause of indigestion by impairing the function of the organs which assimilate the food. Impure air and personal uncleanliness, protracted hot weather, and previous disease are among the common predisposing causes. The strong country child can thrive upon a diet which, given to the more feeble child of the city, would produce deleterious results. During the summer months it often happens that an infant in the city cannot digest properly any food given to it except the mother's milk; and from this results much of the infantile sickness and mortality which make this season of the year much dreaded by parents. There is a natural difference in children as regards liability to disordered digestion. Some do well upon a diet which, given to others similarly situated, occasions vomiting, gastralgia, and flatulence.

In the majority of cases of indigestion, however, the fault does not exist in the child. It is fed too often or irregularly or upon a diet that is unwholesome or indigestible. It is well known that the milk of the mother or the wet-nurse is liable to changes which render it for the time unsuitable for the infant. Her food may be of such a quality, or her mind so excited, or some function of her system so disordered, as to effect a temporary change in the constitution of her milk. The occurrence of the catamenia or of gestation in mothers who are suckling not infrequently produces this unfavorable result.

Indigestion is most common in those infants who, deprived of the mother's milk, are entrusted to wet-nurses or fed from the bottle. The [illegible] the wet-nurse, from not agreeing with the age of the infant, from [illegible] mode of life, from the acescent nature of her food, or from [illegible] are not appreciable, may disagree with the infant and be [illegible]

[illegible] cause of indigestion in the infant is artificial feeding.

This, in the cities, is productive of a great amount of gastric and intestinal derangement and disease. The younger the infant the less frequently does it thrive if brought up by hand.

Whatever care may be bestowed in the preparation of its food, whether cow's or goat's milk or farinaceous substances be used, there is seldom that healthy nutrition which is observed in infants who receive the breast-milk. The "swill milk" in common use among the poor families of this city is totally unfit for the feeding of infants, and is apt to cause flatulence, acidity, and indigestion. Acute indigestion occurs in children of any age from food unsuitable in quality or quantity, which produces gastralgia and other symptoms to be detailed hereafter. Those who suffer habitually from malassimilation are especially liable to such acute attacks.

In the period of childhood chronic indigestion is much less frequent than in infancy, but children are perhaps more subject than infants to the acute form. This is induced by ingesta taken in too large quantity or of a kind which is with difficulty digested. Cherries, currants, raisins, and the parenchyma of oranges and lemons, dried fruits, and confectionery, which are so often heedlessly given to children, are common causes of acute attacks of indigestion. These substances, being but partially digested or not at all, and sometimes accumulating for days in the stomach or intestines, may lead to a very serious and dangerous condition.

Symptoms.—Before describing the symptoms of indigestion I wish to direct attention to one form of vomiting in young infants which is usually attributed to indigestion by the young practitioner, but which really has no pathological significance. I refer to vomiting or regurgitation of milk in hearty and well-nourished infants, resulting from too frequent nursing or over-nursing. It occurs without previous nausea and with little effort. The relatively small size of the stomach in young infants, its position more vertical than in older children, and the little development of the fundus, which is the proper receptacle of the milk, favor this regurgitation. The milk that is ejected is unchanged if it be returned immediately after the nursing, but if some moments have elapsed the casein is more or less coagulated. Little harm is done by this loss of nutriment if the infant appear well and thriving. It is, indeed, salutary, for if the food that is in excess of what is wanted, and in excess of what can be digested, be retained, it undergoes fermentation, and, becoming an irritant, causes indigestion and diarrhœa. The remedy consists in less frequent or less prolonged nursing, and allowing the infant to lie quietly in the crib after each nursing.

But vomiting is a symptom that should always arrest attention and its cause be ascertained. If the child cease to grow and lose its vivacity, the vomiting has pathological significance. Frequent vomiting, without other marked symptoms referable to the digestive apparatus, and with evident loss of flesh and strength, is in most cases a symptom of gastric indigestion or of incipient meningitis. The presence of mucus in the ejected matter, [illegible] and the apparent absence of headache and of other menin- [illegible] t from the vomiting, aid in establishing the diagnosis of [illegible]

[illegible] inary remarks we will proceed to consider the symptoms, [illegible] ext of acute temporary, indigestion.

[illegible], if the milk continually disagree with it, is fretful, [illegible] t ; it seldom smiles, and is not amused by playthings [illegible] rt time. Its features are pallid and bear the appear- [illegible] body and limbs are more or less wasted or are [illegible] frequently present, and sometimes a large mass [illegible] which have evidently lain a considerable time in the stomach. The bowels may be constipated or loose and the evacuations are unhealthy. This state of the infant, continuing, prevents the necessary rest of the mother, and may affect unfavorably her health, so as to reduce the quantity of her milk, or render it still more unwholesome.

In habitual indigestion of young children fermentation of the food occurs to a great extent, instead of normal digestion, and the fermentation results in the production of acids. Whatever irritates the gastro-intestinal surface causes an increased secretion of mucus, and it is believed that the mucus, since it is alkaline, prevents to a great extent the digestive action of the pepsin, which requires an acid medium, so that lactic, butyric, and the fatty acids result. This acid fermentation, beginning in the stomach, extends to the intestines as the food is carried downward. Hence the acid breath, sour-smelling ejecta, fetid stools, flatulence, and colicky pains, indicating both gastric and intestinal dyspepsia, so common in young, improperly-fed infants.

Habitual indigestion is, as might be expected, more common and severe in artificially fed infants than in those at the breast, and it is more likely to result in gastro-intestinal catarrh. In rural localities, where children are much of the time in the open air, have good constitutions, active digestion, and fresh food, dyspepsia is comparatively rare, but in large cities, in which the conditions of life are so different, its occurrence is common. Gross carelessness in the feeding, and ignorance on the part of mothers of the dietetic requirements of young children contribute greatly to its frequency.

Attacks of *acute indigestion* not infrequently occur from careless and improper feeding in children who are habitually dyspeptic, as well as in those whose digestive function is usually well performed. In these acute attacks young children, especially infants, often suffer much from colicky pains, gastralgia, or enteralgia. Their countenance indicates suffering; they utter sharp cries; their thighs are flexed over the abdomen and moved from side to side. Warm spirituous lotions, friction or gentle pressure upon the abdomen, give some relief, especially if they be attended by the expulsion of flatus. Vomiting or an evacuation of the bowels commonly removes the offending substance, and the pain subsides.

Attacks of acute indigestion come on suddenly, and occasionally are so severe that they produce dangerous symptoms, as eclampsia. Apart from pain or a sensation of weight or fulness in the abdomen, symptoms of a reflex character frequently occur, such as headache, drowsiness or languor, sudden twitching of the limbs premonitory of convulsions, and even severe or repeated convulsions. One of the most severe attacks of eclampsia which I have seen occurred in a boy of eight or ten years, induced by swallowing the pulp of oranges which he had been in the habit of eating, and which had accumulated in the stomach and intestines. The expulsion of the offending substance gave immediate relief. In some children with acute indigestion the pulse is notably accelerated, the face flushed, the surface hot, and the temperature elevated two or three degrees above normal.

As the child advances in years and becomes stronger its digestive function is more active, a greater variety of food can be assimilated, and indigestion, whether temporary or habitual, is less frequent than in the first years of life.

Prognosis.—Indigestion in the adult, when not due to organic disease, involves little danger to life, but in infancy its consequences are often serious. Habitual indigestion in the infant, whether due to the bad quality of the ast-milk or to artificial feeding, is liable to cause inflammation of the buccal, hageal, gastric, or intestinal mucous membrane, and in some patients of r more of these divisions of the intestinal tract. Thus, especially in arm months, the acid products of indigestion often cause a dangerous catarrhal inflammation, accompanied by vomiting and frequent stools. Many cases of atrophy in infants, characterized by arrested growth and gradual loss of flesh and strength, till perhaps the features have a sunken and senile appearance from the waste and the skin lies in wrinkles, originate in habitual indigestion. Henoch points out the frequency of gastro-malacia in infants who have suffered from severe dyspepsia accompanied by the abundant production of acids. The softening of the stomach is believed to be largely, if not entirely, cadaveric, the result of post-mortem digestion from the presence of pepsin and the acids of fermentation. The gastric mucous membrane can be readily scraped away by the nail, and it presents a gelatiniform appearance. Sometimes even the stomach is perforated and the adjacent organs are acted on by the corrosive liquids.

If the dyspepsia have not continued so long as to cause inflammatory complications, prompt recovery is probable by the use of suitable food and corrective medicines. If such complications be present, recovery can only be gradual.

DIAGNOSIS.—Habitual indigestion does not usually continue long without the occurrence of more or less gastro-intestinal catarrh. The poor nutrition and appetite, the unhealthy, flatulent stools containing mucus, the vomiting and occasional colicky pains, are symptoms which plainly indicate a dyspeptic origin. Attacks of acute indigestion are also easily diagnosticated, in most instances by the sudden occurrence of the symptoms, such as vomiting, pain in the abdomen, or a sensation of fulness, eructation of gas, etc., and the speedy subsidence of symptoms when the cause is removed. But sometimes, especially in children over the age of two or three years, the symptoms may so closely resemble those of other acute diseases that a careful examination is required in order to make a clear and correct discrimination. Thus I have related above the history of a case in which the high temperature and expiratory moan closely resembled those of pneumonia, but the symptoms quickly abated on the expulsion of a considerable quantity of orange-pulp. An attack of acute indigestion, attended by vomiting, rapid pulse, elevated temperature, with perhaps some erythema, may be mistaken for the commencement of one of the febrile diseases to which children are so liable. If on examination of the fauces no redness of the throat be observed, scarlet fever and diphtheria can be excluded. By a free evacuation of the bowels the symptoms abate and the attack ends, so that if there were any doubt in the diagnosis it is soon dispelled.

When eclampsia results from an attack of acute indigestion, the physician is often compelled to act promptly without a clear diagnosis, but the result of treatment soon renders the nature of the attack apparent.

TREATMENT.—The first indication in treatment is obviously the removal of the cause. In *acute* indigestion, when there is reason to believe that there is some offending substance in the stomach or intestines, if the symptoms occur soon after the substance is taken an emetic may be administered, and ipecacuanha, in syrup or powder, is a safe and usually efficient remedy. If several hours have elapsed a purgative should be given, as castor oil, either alone or in combination with syrup of rhubarb, or an enema of glycerin and water may be employed.

If the symptoms be urgent, especially if convulsions be threatened, we should not wait for the slow action of a purgative, but should resort at once to an enema to open the bowels. Sometimes the pain in acute indigestion is such as to require immediate treatment. I have found in such cases five- to twenty-drop doses, according to the age, of aniseed cordial, made as directed in the National Formulary, a useful remedy. In the infant there is often an excess of acid in the stomach and intestines, which is best treated by alkaline remedies, as lime-water in combination with the opiate. The following mixture will be found useful in such cases:

℞. Tinct. opii deodorat., or liq. opii composit. (Squibbs),	gtt. xij;
Magnes. calcinat.,	gr. xij–xxiv;
Sacch. alb.,	ʒj;
Aq. anisi,	℥iss. Misce.

Dose: The bottle being first shaken, one teaspoonful every two hours to a child a year old until relief of pain. If there be much pain, it is well to add a little chloroform or Hoffman's anodyne to the mixture.

Or the following mixture:

℞. Tinct. opii deodorat., or liq. opii composit.,	gtt. xij;
Bismuth. subcarbonat.,	ʒiss;
Syr. simplic.,	ʒss;
Aq. cinnamomi,	℥j. Misce.

Shake bottle thoroughly and give one teaspoonful to a child of one year.

If in the acute indigestion of infants diarrhœa occur, the camphorated tincture of opium, in combination with chalk mixture, may be given, fifteen drops of the one to a teaspoonful of the other, or the above mixture of laudanum and bismuth may be employed. Infants whose diet consists largely of cow's or goat's milk digest with most difficulty the casein, which often passes the bowels in an imperfectly digested state, or it collects in a large and firm mass in the stomach, causing gastralgia and rendering the child fretful till it is vomited. I have elsewhere recommended, as important to prevent these attacks of acute dyspepsia, the use of the upper third of the milk, which contains less than the average casein. The addition of a little farinaceous food, as barley-water, to the nursing-bottle will sometimes produce the same effect by mechanically separating the particles of milk. Peptonized milk, as recommended in our remarks on the hygienic treatment of Intestinal Catarrh, will also be found useful in certain cases, and also the employment of a good preparation of pepsin at each feeding.

In *chronic* indigestion the means of relief are different. They are twofold: first, as regards change of diet; secondly, measures to improve the digestive function. Spoon-fed infants, suffering from habitual indigestion, require the utmost care as regards the character of their food, its preparation, and the times of feeding. Often it is best, if practicable, to procure a wet-nurse, and sometimes removal to a more salubrious locality is followed at once by improvement in the digestive function. If the infant be already wet-nursed, the milk should be examined microscopically and otherwise, and inquiry should be instituted in reference to the health and diet of the wet-nurse. Sometimes a change of wet-nurse is advisable. (For facts and considerations bearing on this point the reader is referred to the chapters relating to regimen.)

Children with chronic indigestion are occasionally much benefited by the moderate and judicious use of alcoholic stimulants. These should be given sparingly with their food, and should be discontinued as soon as the digestive function is fully restored. M. Donné and some other French writers recommended the habitual use of wine for infants even in a state of health, but there are reasons, moral as well as physical, why alcoholic stimulants should only be used as medicines and not in a state of health.

If the case be one of simple or uncomplicated indigestion, pepsin or lactopeptin of the shops and tonics may be employed. In many instances, however, especially in infancy, gastro-intestinal inflammation has supervened, and in such cases those remedies should be employed which exert a favorable—or at least not an unfavorable—effect on the inflamed surface over which they pass.

In habitual indigestion remedies are obviously required which increase the quantity of the digestive ferments. The following will be found a useful prescription in cases of indigestion in which gastro-intestinal catarrh has supervened:

℞. Acidi hydrochlorici dilut., gtt. xvj–xxxij;
Pepsini puri, in lamellis, ʒj;
Bismuth. subnitrat., ʒij;
Syr. simplic., ℥ss;
Aquæ destillat., ℥iij. Misce.

Shake bottle, and give one teaspoonful before each feeding.

The lactopeptin of the shops is also useful, and when diarrhœa accompanies the indigestion the following may be prescribed:

℞. Bismuth. subnitrat., ʒiij;
Lactopeptin, ʒij;
Pepsini puri, in lamellis, ʒj.

Give as much as goes on a five-cent-piece to a child of ten months before each feeding.

If the stools continue frothy and offensive on account of the fermentation the following will be found beneficial:

℞. Creasoti or acidi carbolici, gtt. ij;
Syr. simplic., ℥ss;
Aquæ destillat., ℥iss. Misce.

Dose: One teaspoonful every two hours to a child of one year.

In children over the age of three or four years the vegetable tonics are often useful, as quinine in half-grain or one-grain doses. Iron may also be given, especially the milder preparations, as the citrate, in anæmic cases.

Among the useful vegetable stomachics and tonics may also be mentioned the compound tincture of cinchona, compound tincture of gentian, infusion of columbo, fluid extract of columbo, and fluid extract of cinchona.

If chronic indigestion be complicated with gastro-intestinal inflammation, subacute or chronic, for this is the form which is usually present, there are still certain tonics which may be advantageously administered. Columbo and the compound tincture of cinchona are often useful in these cases, and of the chalybeates wine of iron or the citrate of iron and ammonium or the liquor ferri nitratis may be safely administered. In most cases, however, change in the diet properly made will be found more useful than tonic and corrective medicines.

Infants affected with diarrhœa from indigestion often improve under the use of powders consisting of equal parts of subnitrate of bismuth and lactopeptin. An infant of three months can take three grains of each every three hours or before each feeding, or it may take three or four grains of the subnitrate of bismuth with half a grain of pure pepsin in scales.

Dyspepsia often rapidly disappears by hygienic measures without the use of medicines, as by removal from the city to the country, outdoor exercise, or, if the patient be an infant, by being carried into the open air daily. In infants also marked improvement is often observed on the approach of the cool and bracing weather of autumn and winter.

CONGESTION OF THE STOMACH.

Passive congestion of the stomach is described among the diseases of this organ by Billard, but it is a pathological state of little importance in itself. It occurs in new-born infants, asphyxiated at birth and with difficulty resuscitated. In these cases there is generally intense capillary congestion throughout the system. The mucous membrane of the stomach is injected, but not more than that of the mouth or intestines. If circulation and respiration be fully established, this injection of the capillaries subsides. No treatment is required, except measures to promote the circulatory and respiratory functions. In cyanosis and atelectasis there is often general congestion of the capillaries of the systemic circulatory system on account of the obstruction to the flow of blood through the heart in the one disease and through the lungs in the other. There is in these cases passive congestion of the stomach, but not more than of other organs.

GASTRITIS.

Inflammation of the stomach, except when produced by the direct contact of some irritant, is rare in infancy and childhood, independently of disease in some other portion of the intestinal tract. Cases have, however, been reported in which it was not known that any irritating ingesta had been taken, and in which a careful examination revealed a healthy or nearly healthy state of other portions of the digestive tube. The subjects were for the most part young infants. The following is an example related by Billard:

An infant, four days old, remarkable for the color of his face and firmness of flesh, refused the breast and vomited yellow, acid matter. On the following day the vomiting had increased, the legs were œdematous, face pallid and pinched, respiration difficult, skin cold, pulse slow and irregular, and pressure on the epigastric region produced cries indicative of pain.

Third day: general sinking; face thin and expressive of great pain; stools natural.

Fourth and fifth days: condition the same. Death occurred on the sixth day, and the autopsy was made on the day following.

With the exception of slight pneumonia no disease was discovered in any part of the system besides the stomach. The mucous membrane of this organ was intensely vascular near the cardiac orifice and along the lesser curvature. This part was also tumefied, and could be easily raised with the finger-nail. The remainder of the gastric surface was hyperæmic, but to a less extent.

This case is interesting as showing what may happen, though rarely. A nursing infant is seized with gastritis without apparently having taken any irritating ingesta and without other disease of the digestive apparatus. It is probable, however, that in cases like the above the cause, if ascertained, would be found in the ingesta; perhaps drinks too hot, perhaps elements of colostrum or pathological elements in the milk, which might produce gastritis in young infants, in whom the mucous membrane is delicate and sensitive.

Gastritis is not uncommon in infancy in connection with inflammation of the intestines. The latter inflammation is sometimes apparently subordinate to the former, and if such patients die the fatal result is due mainly to the gastric disease. The reverse is, however, the rule. The gastritis is ordinarily subordinate to the intestinal catarrh.

CAUSE.—Gastritis, as I have observed it in infants, has been in most cases due in great part to the continued use of improper food—of food not suitable to the age of the child, and which was therefore with difficulty digested.

Milk, acid or otherwise unwholesome, farinaceous substances, stale or of an inferior quality and not properly prepared, drinks too hot or too cold, may be specified among the causes. Therefore this disease is most common in bottle-fed infants, and is comparatively rare in those who receive abundant and wholesome breast-milk. Antihygienic agencies, apart from the diet, no doubt exert some influence in the production of gastritis, as they do of stomatitis. Uncleanliness and residence in damp and dark apartments or in an atmosphere loaded with noxious gases produce a condition of system which strongly predisposes to these inflammations, if, indeed, they may not be enumerated among the direct causes.

Rilliet and Barthez have called attention to the fact that certain medicinal substances given to children occasionally cause gastritis. They have observed this effect from the use of tartar emetic, kermes mineral, and croton oil. Gastritis occurring in this way may or may not be associated with inflammation in contiguous portions of the digestive tube. Elsewhere I have related a case in which gastro-enteritis occurred in a child nine years old after having taken a considerable quantity of kerosene oil for spasmodic croup.

Inflammation of the stomach is thought by some to accompany measles and scarlet fever during the eruptive period, but this opinion is probably incorrect. If it occur, it corresponds with the stomatitis and dermatitis of these diseases, and disappears as they subside. It is mild and accompanied by few symptoms. I have, as stated in the remarks on Scarlet Fever, examined in certain instances the stomachs of those who have died during the eruptive period of these diseases, and found them free from any appreciable inflammatory lesion.

AGE.—From the records of about seventy cases of inflammatory disease of the digestive mucous membrane which I have preserved it appears that gastritis is not common over the age of six months. On the other hand, it is common in infants under the age of three months who are deprived of breast-milk. I have met it chiefly in foundlings fed with the bottle, and having at the same time entero-colitis, and often also stomatitis and œsophagitis. In these cases there is sometimes continuous or almost continuous injection and thickening of the mucous membrane, from the lip to near the pyloric orifice of the stomach, and even beyond this orifice in the intestines. The following is an example of gastritis as it frequently occurs in foundling institutions:

CASE.—R. W——, female, two weeks old, was admitted into the New York Infant Asylum, August 24, 1865, anæmic and somewhat emaciated. She was in part wet-nursed and in part bottle-fed. The emaciation increased, and nearly the entire buccal cavity became covered with the confervoid growth of thrush. On September 4th diarrhœa commenced. Borax was used for the mouth and alkalies and astringents to check the diarrhœa, but without material improvement.

following was the record for September 7th: "Cries almost constantly,
le or whining voice; still has thrush; nurses and does not vomit;
or six daily, and green; pulse 136, feeble." Death occurred Septem-

tember 9th.—Mouth and fauces not examined; mucous membrane
scular in its whole extent, with slight thickening, but without
membrane of stomach injected like that of the œsophagus,
ned, except in its pyloric extremity, where the appearance
; the color in the central part of the inflamed gastric
; no thrush was noticed, except on the buccal surface
curvature of the stomach were white flakes resem-
ich were found by the microscope to consist mainly
ells, without the cryptogamic formation; mucous
healthy in their whole extent, except slightly

increased vascularity in a few places in the ileum; mucous membrane of colon much injected throughout, except near the ileo-cæcal valve, where the vascularity was slight; in the transverse and descending colon the redness was pretty uniform, and the membrane was thickened, but not ulcerated; solitary glands and Peyer's patches moderately elevated.

The observations of Valleix show how frequently gastritis is associated with severe attacks of thrush. In 23 of his cases of the latter disease in which the condition of the stomach was noted after death this organ presented inflammatory lesions in 17, and in three others appearances which may or may not have been due to inflammation.

SYMPTOMS.—A difficulty exists in isolating and defining the symptoms of gastritis, from the fact that it commonly coexists with other inflammations of the digestive tube. Though we may never be able to diagnosticate this catarrh as certainly as we can croup or pneumonia, still there are symptoms which arise directly from the gastritis, and with care we may be able to distinguish them from those symptoms which are due to other pathological states.

If gastritis be acute, pain is present. In the above case from Billard, as well as in a case observed by myself and related under the head of Gelatinous Softening, there were frequent cries, and the countenance indicated much suffering until the stage of collapse. If there be less intensity of inflammation and the disease be more protracted, as is ordinarily the case, the pain is not so severe, and it may be so slight as not to attract attention. Sometimes there is tenderness, so that pressure upon the epigastric region is badly tolerated. Vomiting is regarded as one of the most constant symptoms. The infant after nursing seems in distress till the milk is returned, but it nurses with avidity in consequence of the thirst if it be not too exhausted or feeble. The dejections may be quite regular throughout the disease, as in the case from Billard. There is ordinarily, however, diarrhœa from the presence of entero-colitis. The pulse is sometimes accelerated and sometimes nearly natural. The emaciation in gastritis is rapid, since not only the milk is in great measure vomited, but the digestive function, so far as the stomach is concerned, is seriously impaired. The features become wrinkled and senile, the eyes hollow, the limbs attenuated, and the cranial bones uneven. Death occurs from exhaustion.

ANATOMICAL CHARACTERS.—Simple gastritis may affect the entire mucous surface of the stomach or be limited to a certain part. The part which is most likely to escape is that toward the pyloric orifice. This portion of the organ is sometimes found in nearly or quite the normal state, while the cardiac half or two-thirds is inflamed. The vascularity of the diseased surface is not uniform. In one place there is simple arborescence; in another intense continuous redness; and between these two extremes are different grades of vascularity. The mucous membrane is somewhat thickened, softened, and the secretion of mucus increased. Extravasation of blood is not infrequent under the mucous membrane, usually in points, and the mucus may be mixed with more or less blood. Small shreds or portions of coagulated milk are often found with the mucus attached to the gastric surface. I have observed, though rarely, small superficial ulcers at the point where the inflammation had been most intense.

Dr. A. Jacobi says: "Indeed, the boundary-line between a simple dyspepsia and a gastric catarrh is perhaps never made out clearly. The epithelium of the mucous membrane does not belong to it exclusively, but spreads in the contiguity of the tissues into the muciparous and the peptic glands. Thus the inflammatory condition of the surface becomes at once a parenchymatous affection, though it be possible that an uncomplicated catarrh and an uncomplicated inflammation may have an occasional existence. . . . . Unless a gastric catarrh or a dyspepsia . . . . be relieved at once the merely functional or superficial disorder becomes organic and deep-seated. These changes may refer either to the tissue or the secretion. Inflammatory thickening, erosions, ulcerations, or (Moncorvo) dilatation of the stomach will be observed in a great many instances. The secretions become abnormal; the normal hydrochloric acid of the gastric juice is almost invariably diminished. . . . . Lactic acid, however, is produced in much larger quantities than the first stage of digestion requires, and with it acetic, butyric, and the rest of the fatty acids."[1]

Diagnosis.—In protracted cases, when entero-colitis is present, it is difficult to make a positive diagnosis. Our opinion must then be little more than a plausible conjecture. In the acute attacks we can diagnosticate the gastritis with more certainty. If a young infant affected with sprue be seized with pain, and vomits often; if emaciation be rapid and there be no diarrhœa, or diarrhœa not sufficient to account for the prostration; if the buccal mucous membrane, dotted with the points of thrush, present a dry appearance and the deep-red color of severe stomatitis,—there can be little doubt of the presence of gastritis. The diagnosis is rendered more certain by signs of tenderness when pressure is made upon the epigastric region.

Prognosis.—Like other inflammations, gastritis is probably sometimes so mild that it does not materially increase the suffering or danger of the child. This mild form of the disease under favorable circumstances soon subsides. In other cases, by the continuance or increase of the cause, the inflammatory process becomes more severe and extensive, resulting even in disintegration of the mucous membrane. Those cases are especially severe and likely to end fatally which are protracted and accompanied by severe thrush, with a desiccated appearance of the buccal surface or with entero-colitis. Pain, vomiting, and rapid emaciation in such children indicate the speedy approach of death. Improvement in the stomatitis or entero-colitis is a favorable indication, but these inflammations may improve without corresponding improvement in the gastritis.

Treatment.—All foods or drinks, except those of a bland and unirritating nature, should be forbidden. If practicable, the young infant should take no nutriment except the mother's milk or that of a wet-nurse. Since there is an excess of acid in inflammation of the mucous coat of the digestive tube, lime-water may be advantageously given in combination with breast-milk. Opium is required to relieve the pain and quiet the action of the stomach. The camphorated tincture of opium, in doses of four or five drops to a child a month old, or the syrup of poppy, tincture of opium, or liquor opii compositus in proportionate doses, may be administered. If there be thirst a little gum-water should be given frequently. If there be much emaciation and the vital powers are failing, it will be necessary to resort to the use of stimulants. Stimulating enemata are preferable to stimulants given by the mouth. Much benefit may be anticipated from local measures. Irritation should be produced upon the epigastrium by mustard or other means, followed by fomentations. It is rarely, perhaps never, proper to use leeches if the patient be an infant. Death occurs from exhaustion, and it is therefore important that the vital powers should not be reduced. If the child be weaned, the diet at first should be restricted to arrowroot, rice-water, barley-water, or similar bland substances. In advanced stages of gastritis animal broths and jellies may be required. To relieve the thirst, carbonic-acid water, Vichy water, or plain water acidulated with a few drops of hydrochloric acid may be employed. If symptoms of indigestion continue, it may be best to employ bismuth and pepsin after the gastritis has abated.

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[1] *Arch. of Pediatrics*, Aug., 1889.

FOLLICULAR GASTRITIS; DIPHTHERITIC GASTRITIS.

The pathological character of *follicular* gastritis is similar to that of follicular stomatitis. It is an inflammation affecting the gastric follicles and ending in their ulceration. It is not a frequent disease; it occurs in young infants. Billard observed fifteen cases. The symptoms in these patients were similar to those in simple gastritis of a severe form. The emaciation and prostration were rapid, and death occurred early. We can only diagnosticate the gastritis without determining its follicular character. How many recover it is impossible to ascertain, but the disease is likely to be fatal on account of the intensity of the inflammation, not only of the follicles, but of the intervening mucous membrane. The treatment is that of gastritis.

Diphtheritic gastritis is infrequent. It occasionally occurs during epidemics of diphtheria. Allusion is elsewhere made to a case treated in the Nursery and Child's Hospital of this city in December, 1859. The patient, eighteen months old, previously had had protracted entero-colitis, and died exhausted after a brief attack of diphtheria. There were lesions referable to the entero-colitis, and the body was much emaciated. The diphtheritic exudation was found covering the fauces, epiglottis, glottis to the rima glottidis, the entire œsophagus, and almost the entire stomach. The mucous surface underneath was injected; that of the œsophagus and stomach especially was very vascular, softened and thickened, and the submucous connective tissue was infiltrated.

The pseudo-membrane taken from the epiglottis and examined under the microscope presented an amorphous appearance; no cells were noticed in it, and fibrillation was not distinct; that from the stomach was found to consist almost entirely of cells, the plastic corpuscles of some writers, the pyoid of others. The digestive process, so far as the stomach was concerned, had evidently been almost if not entirely suspended, and hence in part the sudden prostration. Diphtheritic gastritis probably does not occur without general infection of the system with the diphtheritic virus. The proper treatment is the use of lime-water or one of the solvents of pseudo-membranes which do not irritate the mucous membrane, while the constitutional treatment proper for diphtheria is employed.

DILATATION OF STOMACH.

The stomach may undergo abnormal dilatation, according to Dr. A. Jacobi, from overfeeding with bulky, especially amylaceous, food; from diminished contractility in its muscular coat consequent on debility; from imperfect digestion and flatulence; from catarrhal gastritis and peritoneal adhesions. In its treatment he recommends medicines (as bismuth) which diminish fermentation, the avoidance of fats and starches, and large quantities of fluid ingesta. Milk may be given in small quantities and often. Diarrhœa due to this state of the stomach, Jacobi says, may require astringents, as tannin. Raw beef, beef peptones, and peptonized milk are useful, as is also an abdominal binder. Faradic and galvanic currents have been used with some advantage, and the tincture of nux vomica or strychnia, gr. $\frac{1}{120}$ to $\frac{1}{160}$, three times daily, will increase the contractility of the muscular coat of the stomach.[1]

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[1] *Arch. of Pediatrics*, Aug., 1889.

GASTRO-MALACIA.

It is now many years since the attention of the profession was directed to disorganization of the coats of the stomach which is sometimes observed at post-mortem examinations. John Hunter first ascertained that the gastric juice begins to have a solvent effect on the tissues of the stomach soon after death. Though Hunter erred when he stated that the coats of the stomach are more or less digested in all or nearly all cases, it is certain that post-mortem digestion does take place in many cadavers, so that in a few hours after death the gastric mucous membrane is destroyed to a greater or less extent, and occasionally the stomach is perforated or is even severed from its connection with the œsophagus. I have seen several examples of this post-mortem digestion in infants.

Most cases of supposed pathological softening of the stomach reported by the older observers seem to have been such as I have described—namely, cadaveric. It is now believed by pathologists that gastro-malacia always occurs as a cadaveric change, or, if it be pathological in exceptional instances, it in such cases takes place when the individual is nearly or quite moribund and the circulation of blood in it has come to the standstill.

The so-called white softening of the stomach has been observed chiefly in the bodies of those who during life were anæmic and ill-nourished. The mucous membrane in such cases has lost its firmness, and is easily separated from the subjacent tissue. This softening has no connection with any inflammatory process. It is the result of the low vitality of the patient. I believe that in a large proportion of infants whose systems have been reduced and blood impoverished for a considerable time the gastro-intestinal mucous membrane will be found after death less firm and resisting than in those who have been habitually robust.

A vague opinion exists in the minds of most physicians as to the nature, and even appearance, of the so-called *gelatinous* softening of the stomach, and the following observations will be cited in order to give a clearer idea of it:

Billard has recorded two cases with his usual minuteness, and adds: "What inference shall be drawn from the preceding facts and considerations? None other than that the gelatinous softening of the stomach consists in a disorganization of the mucous membrane of this viscus, caused by an acute or chronic phlegmasia; that this disorganization is characterized by an accumulation of serum in the walls of this organ; the intumescence and gelatinous consistence of the mucous membrane in a part usually circumscribed are situated more frequently in the greater curvature, and about which the membrane exhibits more or less evident traces of an acute or chronic phlegmasia. . . . . The softening now under consideration must not be confounded with another kind of softening" (white), "which does not usually succeed an acute phlegmasia."

West, in speaking of gelatinous softening, says: "Softening of the stomach varies in degree from a slight diminution in the consistence of the mu[illegible] membrane to a state of complete diffluence of all the tissues of the [illegible] . . . When the change is not far advanced the exterior of the [illegible]erfectly natural appearance, but on laying it open a [illegible]owish tenacious mucus, like the mucilage of quince-[illegible]adhering to its interior over a more or less considerable [illegible]d of this organ."

[illegible]ys: "T[illegible]ing often proceeds from the interior toward [illegible] there [illegible]ning simple separation of the fibres by a mucus [illegible]ence the parietes are thickened and semi-transparent. . . . . If the transformation be complete, the disorganized portions are removed layer after layer, those which remain becoming gradually thinner. The peritoneum alone resists for some time, but at length it is attacked, worn, and gives way, and perforation of the stomach results. The parts thus transformed are colorless, transparent, apparently inorganic, completely deprived of vessels, and exhaling an odor resembling that of milk."

Bouchut remarks: "Softening of the mucous membrane of the stomach in children at the breast is not a special disease which it is necessary to describe by itself. This alteration is always connected with other diseases, and especially with disease of the large intestine, the knowledge of which fact has been too long neglected. It is the consequence of the acidity of the liquids contained in the digestive tube of young children—liquids which are very acid in the disease we have above referred to."

Rokitansky says of this form of softening: "If we consider, in addition to the above remarks, the uniform localization of the disease, that in none of its stages it presents, either at the point of the softening or in its vicinity, hyperæmic injection or reddening, and that we are still less able to demonstrate upon the inner surface of the stomach or in the tissue of its coats the products of inflammation, we are constrained to infer the non-inflammatory nature of the affection."

Without extending these extracts it is seen that eminent authorities not only disagree in reference to the cause of gelatinous softening of the stomach, but that they also differ in their description of its appearances. This diversity of opinion is most likely attributable to the fact that the two kinds of softening have been confounded. Rokitansky and Bouchut probably refer to cases of white softening which occur in atonic states of the tissues in feeble infants, and therefore have concluded that softening of the stomach is not inflammatory. I believe, from my observations, that the opinion of Billard is correct, and that true gelatinous softening is sometimes found in stomachs that have been inflamed, but it may be in such cases cadaveric.

The following case, which was watched by myself with great interest from beginning to end, was an example of softening following gastritis:

CASE.—G. S.——, male, robust, was born July 10, 1865. The mother not being able to suckle the infant, and the danger of artificial feeding in the warm months being well understood, a wet-nurse was procured. About the 14th of July, this wet-nurse having insufficient milk, another was procured temporarily, who suckled the infant till July 20th, when a third wet-nurse was engaged, whose child, healthy and thriving, was six weeks old. Previously to this time the infant appeared well. It had uniformly nursed vigorously and seemed satisfied.

On the 22d of July thrush, apparently mild, was observed in the mouth, and a powder, supposed to be borax, and labelled such, was obtained at a drug-store to be used as a wash for the mouth. This powder was afterward ascertained to be alum. Five grains were dissolved in as many teaspoonfuls of water, and the mouth of the child was swabbed occasionally with it. A piece of linen, folded so as to resemble the tip of a nursing-bottle, was occasionally dipped into the solution, and the infant was allowed to suck it. The use of the alum was commenced about 6 P. M. In the first part of the evening the infant slept considerably, and of course did not nurse often, but about 8 P. M. it began to be very fretful, and it then nursed more frequently. It vomited once between 8 and 10 o'clock P. M. In order to quiet the infant the tip soaked in the solution was often applied to the mouth, but there was scarcely any intermission in its crying.
ough the night it vomited again once or twice, and about the middle of the
t had one free liquid stool, which was passed with much tenesmus. The
enance of the infant was indicative of suffering, and its thighs were repeat-
lexed over the abdomen, as if that were the seat of its distress. Paregoric

bacteria. The bacteria lactis aërogenes undergo no farther increase in the lower part of the small intestines and in the colon, but the colon bacteria (bacterium coli commune) undergo a great increase in number in the lower part of the ileum and in the colon. They exist in large numbers in the entire length of the colon, and of larger size than in the small intestine. The bacterium lactis aërogenes occurs in the form of "short, thick rods, with rounded ends." Injected into the blood of guinea-pigs and rabbits, it causes death, preceded by the phenomena of intestinal catarrh. The bacterium coli commune is believed to be always present in feces, whatever the diet. It is also rod-shaped and it varies in size and length, the largest and longest specimens attaining the length of five micro-millimetres. According to Booker, both these microbes promote fermentation in the intestines. Many other forms of bacteria have been discovered in the milk-feces of infants, in addition to the two which we have described. Escherich discovered twelve varieties, micrococci and bacilli.

To the physician the gastro-intestinal bacteria are mainly interesting on account of the supposed causal relation which they sustain to certain abnormal conditions of the digestive tract, especially to the diarrhœal affections. It is important in investigating this subject to ascertain what bacteria are present in normal feces, and whether they exert pathogenic action under certain circumstances. This has been, in a measure, ascertained, as we have seen, but another interesting and important inquiry relates to new forms of bacteria that appear in the feces in diseased conditions of the stomach and intestines, and the causal relation which they bear to these conditions. New forms of bacteria may appear in the feces in gastro-intestinal disease without sustaining a causal relation to it or influencing it. Again, although not causing the disease, they may influence its course and duration, or they may cause gastro-intestinal disease by lodging in the food, especially in milk, and producing by their agency poisonous chemical substances in it before it is employed in the nursery. The well-known poisoning by the tyrotoxicon in the hotels at Long Branch, this poison being produced in milk probably by microbic action six or eight hours after the milking, was an instance of this kind. Again, a species of bacteria not occurring in the stools in health, but appearing in disease, as in indigestion, inanition, or diarrhœa, may be the chief factor in causing this morbid state.

According to Booker, none of the gastro-intestinal secretions has an injurious effect on bacteria, except the gastric juice, but certain bacteria are antagonistic to others, so that their presence prevents the full development of the latter. Bacteria, which in the normal state of the gastro-intestinal tract do not find a soil suitable for their development in the stomach or intestines, obtain the conditions favorable for their growth and propagation in diseased states, as when indigestion or catarrh is present.

The pathogenic action of bacteria in the digestive tract can be most successfully investigated by experimenting with them when they have been isolated from other substances by repeated cultivations. Hayem and Lesage have isolated a bacillus which they have discovered in green stools of infants, and which they believe produces by its disturbing action the green color and abnormal state of the stools. The green color in the feces of infantile diarrhœa they believe to be sometimes due to an excess of the bile-pigment, but in other instances is produced by the action of a bacillus, which occurs especially in the upper two-thirds of the small intestine, where it attains the length of two to three micro-millimetres. Injected into the blood of sucking animals, this bacillus appeared in the duodenum ten or twelve hours subsequently, and, increasing in number, caused green coloration of the intestinal contents. The same result was produced when this microbe was administered in the ingesta. In its dry state it floats in the air, so that when an infant having green stools produced by its action enters a ward, others are liable to be attacked with the green diarrhœa if its soiled diapers are allowed to dry in the room.

Baginsky has investigated the stools in the acid diarrhœa of infants, and has isolated two forms of bacteria which liquefy gelatin. One of these produces green coloring matter, and is probably the same as that described above; the other was constantly present in the acid diarrhœal feces, was poisonous to animals, and it is probably impotent in the pathogenic rôle. Baginsky believes from his observations that the bacterium lactis aërogenes present in the normal stools of the suckling is under favorable circumstances antagonistic to the development of pathogenic organisms.

Dr. Booker has isolated forty bacteria from the stools of 30 infants, all seriously sick with diarrhœal diseases, 11 having cholera infantum, 14 catarrhal enteritis, and 5 dysentery. The largest number of these organisms occurred in cases of cholera infantum, and the next largest number in cases of catarrhal entero-colitis. According to Booker, the bacteria of the normal milk-feces still appear in the diarrhœal stools. The bacterium coli commune was found by him in all the diarrhœal cases, but its number appeared to diminish according to the severity of the attack. On the other hand, the bacterium lactis aërogenes occurred in larger number in the diarrhœal stools than in healthy milk-feces. Booker discovered bacteria of the proteus group in 7 of the 11 cases of cholera infantum; which is a matter of significance, inasmuch as Escherich did not find any bacterium of this group in normal milk-feces.

In a very interesting and instructive paper read before the American Pediatric Society in June, 1890, Dr. Victor C. Vaughan detailed his experiments, which showed that "three micro-organisms, differing sufficiently to be recognized as of different species, produce poisons, all of which induce vomiting and purging, and when used in sufficient quantity, death" in cats and dogs experimented on. Dr. Vaughan concludes his paper with the following aphorisms: "1st. There are many germs, any one of which, when introduced into the intestine of the infant under certain favorable circumstances, may produce diarrhœa. 2. Many of these germs are probably truly saprophytic. 3. The only digestive secretion which is known to have any decided germicidal effect is the gastric juice. Therefore, if this secretion be impaired, there is at least the possibility that the living germ will pass on to the intestine, will there multiply, and will, if it be capable of so doing, elaborate a chemical poison, which may be absorbed. 4. Any germ which is capable of growing and producing an absorbable poison in the intestine is a pathogenic germ. 5. The proper classification of germs in regard to their relation to disease cannot be made from their morphology alone, but must depend largely upon the products of their growth."

CHAPTER VII.

SIMPLE DIARRHŒA.

DIARRHŒA is frequent during the whole period of infancy. French writers describe several varieties, according to the character of the evacuations, as acescent, mucous, and serous. M. Rostan even describes fourteen distinct kinds. But the tendency of medical science in modern times is to simplify the nomenclature of diseases—to describe under a single name those affections which are essentially the same, though differing somewhat in their features. Now, all the forms of diarrhœa in the infant may be so grouped as to reduce the number to not more than three or four. In this way repetition and prolixity are avoided, as well as an unnecessary refinement.

The most common form of diarrhœa is that enunciated in our heading. But often a diarrhœa which is non-inflammatory at first becomes a catarrh. Thus the simple diarrhœa of infancy may become an entero-colitis from the continued use of improper diet.

Causes.—These are various. Conditions or agencies which have no appreciable effect in the adult often increase the number of evacuations in young children. Food which imperfectly digests, and some of which perhaps ferments, stimulates the intestinal follicles to excessive secretion, and increases the peristaltic movements by its irritating action, thus causing diarrhœa. Too frequent and abundant feeding is another cause, especially in young infants, some of whom may vomit the suplus food and remain well, but others do not. Food which cannot be assimilated becomes an irritant in consequence of fermentative change, and produces frequent and unhealthy evacuations. In the light of our present knowledge we assign to the agency of intestinal bacteria an important causal relation to those forms of diarrhœa which are attended by fermenting, imperfectly-digested, and unhealthy stools.

The mother's milk or the milk of the wet-nurse may disagree, either from some temporary derangement of her system or continued ill-health, or from causes which are not understood. Diarrhœa in the nursling is the result.

Fright or strong mental impressions will also in some children increase the number of evacuations. This cause being transient, the diarrhœa soon subsides.

Another cause is exposure to cold. Children who are insufficiently clothed in the winter season, who are taken from a heated room into a cool one without sufficient protection, or who lie uncovered at night, are very subject to diarrhœal attacks from the impression of cold on the system.

The cause of simple diarrhœa may exist in the child itself. In some children the evolution of the teeth is attended by a relaxed state of the bowels, which ceases when the gum is pierced. Worms in the intestines may also operate as a cause. Diarrhœa is occasionally salutary within certain limits, and of course it is not strictly correct to call it a disease when it is a means of relief. If occurring from excessive or irritating ingesta, it is obviously conservative.

Symptoms.—Diarrhœa may come on suddenly; at other times there are precursory symptoms continuing for some days. Whether or not there be antecedent symptoms depends chiefly on the cause. If this be exposure to cold or the use of improper aliment, it commonly occurs immediately.

Among the prodromic symptoms sometimes present are restlessness, disturbed sleep, transient abdominal pains, nausea or vomiting, and other symptoms of indigestion. The stools in simple diarrhœa differ much in color and consistence in different cases, and perhaps at different periods in the same case. In infants they are often green. This color, which is a source of anxiety to the inexperienced, and especially to the parents, is often produced by trivial causes. Slight indigestion will produce it, and so will excess of food, even when bland and unirritating. In our remarks on the gastro-intestinal bacteria we have stated that a microbe has the power to produce the green color. The stools in infantile diarrhœa often contain particles of coagulated casein, but in children advanced beyond the period of first dentition they do not differ materially in appearance from the evacuations of the adult. They are usually passed easily, but if they be acid or in any way irritating there may be more or less tenesmus, especially in infants. Sometimes before the evacuations there is a sensation of fulness in the abdomen. In that form of diarrhœa which has been designated acescent not only are the stools acid, but matters vomited have an acid odor and give an acid reaction.

During the quiet hours of sleep, when no foods and drinks are taken, the diarrhœa diminishes. If the complaint be slight, there is little thirst; but if the stools be frequent and thin, especially if they approach the watery character, the patient is thirsty. The appetite varies, the tongue is moist and covered with a light fur, and there is often more or less meteorism, but no abdominal tenderness.

The features in this disease are pallid. In a few days, if the evacuations continue, there is evident loss of weight and flesh. The rotundity of the limbs is gradually lost and the tissues become soft and flabby. But in most cases when the malady has reached this stage its original character is lost, and it has become inflammatory.

Certain epiphenomena, as Barrier terms them, occur at times in non-inflammatory as well as in inflammatory diarrhœa; as, for example, a sympathetic cough or, which is more serious, cerebral complications. Convulsions or stupor, indicating the supervention of spurious hydrocephalus, may occur in either form of diarrhœa. This disease is described elsewhere. More or less fever may occur in simple diarrhœa, but it is not constant and the pulse may or may not be accelerated.

ANATOMICAL CHARACTERS.—It is obvious from the nature of simple diarrhœa that it is attended by little or no structural changes perceptible to the anatomist. In cases supposed to be simple or non-inflammatory, which have ended fatally either from the diarrhœa or an intercurrent disease, the most marked leisons observed have been more or less tumefaction of the intestinal glands, with perhaps diminished firmness and resistance of the mucous membrane. Cases like the following, which have usually been regarded as non-inflammatory, are not infrequent, but it seems to me probable that in at least a certain proportion of such cases the intestinal follicular apparatus has passed beyond the physiological state of an exaggerated functional activity, and that the disease should be designated a catarrh or inflammation. Inasmuch as non-inflammatory diarrhœa, if protracted, is very liable to become inflammatory, it is often difficult to determine whether the malady has undergone this change, even with the aid of post-mortem inspection.

On the 7th of July, 1865, a foundling one month old died at the Infant Asylum. It was much emaciated, with eyes sunken and features pinched, at the time of its death. It was wet-nursed to the close of its life, but the nurse's milk was insufficient. It did not vomit, did not have any marked acceleration of pulse (128 per minute), and its evacuations were about four daily, and thin. The stomach and intestines were pale throughout. The solitary glands, particularly those in the colon, and the patches of Peyer, were tumefied so as to be visible and somewhat raised above the surrounding surface. But no lesions being observed which are characteristic of inflammation, the disease was regarded as non-inflammatory.

Niemeyer, with others, describes even the mildest forms of diarrhœa under the term catarrhal inflammation, and he appears to consider the transient effects of a purgative as an incipient catarrh. But it seems to me preferable, in the present state of pathological knowledge, to regard all those diarrhœas which immediately abate with the removal of the cause, and which are attended by no marked anatomical change, as non-inflammatory or simple. They are characterized by increased secretion of the intestinal follicles and increased peristalsis.

Prognosis.—In a large proportion of cases simple diarrhœa is not dangerous. With the adoption of suitable measures to remove the cause and the use of medicines to control the discharges the patient recovers. The remark already made may be repeated here, that occasionally diarrhœa is salutary within certain limits, as when there is a foreign substance in the intestines either irritating mechanically or by its chemical properties, and which the diarrhœa serves to remove.

The danger arises from complications, as spurious hydrocephalus, or from the emaciation and exhaustion, or from its eventuating in inflammation.

If the rotundity of the figure and firmness of the tissues be preserved, showing that alimentation is still sufficient, and no complication arise, the diarrhœa is not as a rule dangerous. In infants that over-nurse and do not vomit the surplus milk, the evacuations are sometimes green and frequent, and yet fulness of figure is preserved and the development of the body proceeds as usual. On the other hand, diarrhœa attended by emaciation or softness or flabbiness of the flesh involves danger and requires immediate treatment.

Treatment.—It is necessary, in order to treat diarrhœa in infancy and childhood successfully, to ascertain the cause, and, as far as possible, to remove it. It is not till the cause ceases to operate that we can expect a satisfactory result from medication. The disease may be temporarily relieved by medicine, but it usually returns at once when treatment is omitted, unless the patient be removed from the influence of the agencies which produce it. These remarks are especially applicable to the diarrhœa of infants. With them very generally, when affected with this complaint, there is some fault as regards the quantity or quality of food. Attention to this matter will show the need of a change of wet-nurse, or, if the infant be spoon-fed, a change in the character of its food or in the mode of preparation, or even in the quantity given. Sometimes by change in the diet and the adoption of hygienic measures the complaint ceases, so as to require no medication. Sometimes the temporary abstinence from milk-food, and the employment of barley gruel in its place or the use of barley gruel and peptonized milk, suffice to cure the diarrhœa. If medicines be needed and the symptoms are not urgent, it is occasionally advantageous to commence treatment by the use of one of the milder purgatives in a small dose. In the *infant*, in whom the dejections are so generally acid, an alkaline laxative or a laxative conjoined with an alkali often has a good effect as preliminary treatment. Half a teaspoonful to one teaspoonful of castor oil or a proportionate dose of calcined magnesia removes any acid or irritating substance from the intestines, and is followed by a diminution in the number of stools. The improvement, however, without subsequent treatment is usually only for a day or two. In this city a purgative dose of castor oil is often given as a domestic remedy in infantile diarrhœa, the beneficial effect from it having popularized its use for this purpose. Trousseau usually gave Rochelle salts, but this medicine is too severe and dangerous for the treatment of infantile diarrhœa, especially in warm months.

If there have been previous constipation and the diarrhœa have just commenced, a purgative is obviously indicated. West says: "Provided there neither much pain nor much tenesmus, and the evacuations, though y, are fecal and contain little mucus and no blood, very small doses of lphate of magnesia and tincture of rhubarb have seemed to me more than any other remedy:

℞. Magnesiæ sulphatis,	ʒj ;	
Tinct. rhei,	ʒj ;	
Syr. zingiberis,	ʒj ;	
Aquæ carui,	ʒix.	Misce.

ʒj ter die for children one year old.

I seldom fail to observe from it a speedy diminution in the frequency of the action of the bowels, and a return of the natural character of the evacuations."

Since many cases of simple diarrhœa are due to the use of food which does not readily digest, but undergoes in part fermentation, the food should be carefully selected and prepared according to the directions given in the chapters relating to artificial feeding. In cases of fermentation, due often to microbic agency, the digestion is very imperfect, and the diarrhœa which results is often best treated, so far as medicines are concerned, by the use of pepsin and bismuth subnitrate, as ten or fifteen grains of pepsinum saccharate and bismuth subnitrate, given at each feeding, with perhaps an equal quantity of bismuth in mistura creta midway between the feedings.

In the simple diarrhœa of infants the compound powder of chalk and opium is sometimes an excellent medicine, containing as it does an astringent with the opiate and alkali. It may be given in doses of three grains to a child one year old every three hours midway between the feedings. The following is a convenient formula for administering substantially the same medicines in the liquid form:

℞. Tinct. opii deodorat.,	gtt. xvj ;	
Bismuth. subnitrat.,	ʒij ;	
Syr. simplic.,	℥ss ;	
Mistur. cretæ,	℥iss.	Misce.

Shake well, and give one teaspoonful every three hours between the feedings.

I often employ this prescription or one similar to it at my first visit. If the patient be not relieved by the opiate, alkali, and bismuth, and by proper regimen, in all probability inflammation of the intestinal mucous membrane is present. In patients over the age of two or three years simple diarrhœa approaches in character that of the adult, and the treatment appropriate for the adult is proper in these cases, allowance being made for the difference in age. In infants, in whom this disease, if protracted, very soon becomes an undoubted entero-colitis, attended if it be protracted by emaciation and weak heart, alcoholic stimulants are often required at an early period on account of the prostration and feeble power of endurance.

CHAPTER VIII.

INTESTINAL CATARRH OF INFANCY (ENTERO-COLITIS).

It is customary with writers to treat of inflammation of the small and large intestines in infancy as a single disease, for the following reasons: First, the symptoms of colitis at this period of life do not ordinarily differ, in any marked degree, from those of enteritis. The tormina, tenesmus, and abdominal tenderness which characterize colitis in childhood and adult life are ordinarily lacking or are not appreciable by the observer, and the mucosanguineous evacuations are oftener absent than present. On account of this absence of symptoms Bouchut says: "Dysentery is a very rare disease among young children. Its existence might even be denied if it had not been observed at the period of some severe epidemics of dysentery." If Bouchut refers by the term dysentery to the ordinary phenomena of that disease, his remark is correct; but as regards the lesions it is erroneous, for colitis is a common infantile malady. Billard, after analyzing eighty cases of intestinal inflammation in infants, says: "From this calculation it is evidently very difficult to make a correct diagnosis of inflammation of the intestinal tube in sucking infants, yet it would seem as if the proper signs of enteritis or ileitis were the rapid tympanitis of the abdomen, the diarrhœa, accompanied with vomiting; while in colitis, diarrhœa alone, without tympanitis, is the most frequent." And again: "In consequence of the impossibility we have found to exist of tracing with exactitude the series of symptoms proper to inflammation of the different portions of the digestive tube, we shall content ourselves with presenting an analytical sketch of the causes, symptoms, and ordinary course of inflammation of the mucous membrane of the intestines in general."

The frequent absence of any pathognomonic symptom or sign by which to determine the exact seat of intestinal inflammation in the infant is admitted by recent observers as well as Billard.

The second reason why intestinal inflammation in the infant is described as a single disease is, that enteritis and colitis in the majority of cases coexist. This will be seen when we come to speak of the anatomical characters.

In rural districts infantile diarrhœa is not so prevalent and fatal as in cities. In the farming sections it does not materially increase the death-rate, and it is therefore not so important a malady as in cities. In cities it largely increases the aggregate of deaths. Especially fatal is that form of it which is known as the summer epidemic, as is seen by the mortuary records of any large city. Thus, in New York City during 1882 the deaths from diarrhœa reported to the Health Board, tabulated in months, were as follows:

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Under five years . .	34	32	50	50	72	231	1533	817	362	195	68	35
Over five years . . .	14	15	14	20	15	19	131	149	84	55	31	24

It is seen that in 1882 in New York City the deaths from diarrhœa under the age of five years were greatly in excess of the number during the whole period of life subsequently to that age.

The following statistics show how great a destruction of life this malady causes even under the surveillance of an energetic Health Board; and before this Board was established it was much greater, as I had abundant opportunities to observe. The last annual report of the New York Board of Health was made in 1875, since which time weekly bulletins have been issued. The deaths from diarrhœa at all ages in the last three years in which annual reports were issued were as follows:

	1873.	1874.	1875.
January	94	43	46
February	84	34	52
March	93	40	58
April	114	47	45
May	95	61	89
June	220	144	157
July	1514	1205	1387
August	967	1007	1012
September	424	587	608
October	213	255	185
November	87	105	57
December	53	56	50

In its annual report for 1870 the Board states: "The mortality from the diarrhœal affections amounted to 2789, or 33 per cent. of the total deaths; and of these deaths, 95 per cent. occurred in children less than five years old, 92 per cent. in children less than two years old, and 67 per cent. in those less than a year old." Every year the reports of the Health Board furnish similar statistics, but enough have been given to show how great a sacrifice of life infantile diarrhœa produces annually in this city.

What we observe in New York in reference to this disease is true also, to a greater or less extent, in other cities of this country and Europe, so far as we have reports. Not in every city is there the same proportionate mortality from this cause as in New York, but the frequency of infantile diarrhœa and the mortality which attends it render it an important disease in, I believe, most cities of both continents. In country towns, whether in villages or farm-houses, this disease is comparatively unimportant, inasmuch as few cases occur in them, and the few that do occur are of mild type, and consequently much less fatal than in cities.

The comparative immunity of rural districts has an important relation, as we will see, to the hygienic management of these cases.

Etiology.—The intestinal catarrh of infants is occasionally produced by taking cold. Infants insufficiently protected by clothing and exposed to sudden changes of temperature or to currents of air in the apartments where they reside, or heedlessly exposed outdoor by careless nurses, sometimes become affected with diarrhœa, even of a fatal character. They contract an intestinal inflammation from taking cold, just as other infants may contract coryza or bronchitis from the same cause.

But the most common causes of infantile diarrhœa are, first, the use of food which is unsuitable for infantile digestion, and which therefore acts as an irritant; and, secondly, residence in a foul atmosphere, to which we will soon call attention, and which largely increases the percentage of deaths in our cities during the hot months. Diarrhœa due to taking cold occurs in all localities and climates, but it is obviously most common in times of changeable weather. That due to the use of unsuitable food and foul air occurs for the most part in cities, and much more frequently in the summer season than in the cool months, as the above statistics show. Infantile intestinal catarrh, however produced, presents nearly the same anatomical characters, so that, whatever its etiology, it is proper to describe it as one disease; but that form of it which requires most elucidation, and the causes of which we will consider in the following pages, is that produced by impure air and improper diet.

The prevalence and severity of infantile diarrhœa in cities correspond closely with the degree of atmospheric heat, as may be inferred from the foregoing statistics. In New York this disease begins in the month of May—earlier in some years than in others—in a few scattered cases, commonly of a mild type. Cases become more and more numerous and severe as the weather grows warmer, until July and August, when the diarrhœa attains its maximum prevalence and severity. In these two months it is by far the most frequent and fatal of all the diseases in the cities. In the middle of September new patients begin to be less common, and in the latter part of this month and subsequently new cases do not occur, unless under unusual circumstances which favor the development of this malady. In New York a considerable number of deaths of infants occur from diarrhœa in October. October is not a hot month in our latitude—its average temperature is lower than that of May—and yet the mortality from this disease is considerably larger in the former than in the latter month. This fact, which seems to show that the prevalence of the summer diarrhœa does not correspond with the degree of atmospheric heat, is readily explained. The mortality in October, and indeed in the latter part of September, is not that of new cases, but is mainly of infants, as I have observed every year, who contract the disease in July or August or earlier, and linger in a state of emaciation and increasing weakness till they finally succumb, some even in cool weather.

The fact is therefore undisputed, and is universally admitted, that the summer season, stated in a general way, is the cause of this annually recurring diarrhœal epidemic. That atmospheric heat does not in itself cause the diarrhœa is evident from the fact that in rural districts there is the same intensity of heat as in cities, and yet the summer complaint does not occur. The cause must be looked for in the state of the atmosphere engendered by heat where unsanitary conditions exist, as in large cities. Moreover, observations show that the noxious effluvia with which the air becomes polluted under such circumstances constitute or contain the morbific agent. Thus, in one of the institutions of this city a few years since, on May 10th, which happened to be an unusually warm day for this month, an offensive odor was noticed in the wards, which was traced to a large manure heap that was being upturned in an adjacent garden. On this day four young children were severely attacked by diarrhœa, and one died. Many other examples might be cited showing how the foul air of the city during the hot months, when animal and vegetable decomposition is most active, causes diarrhœa. Several years since, while serving as sanitary inspector for the Citizens' Association in one of the city districts, my attention was particularly called to one of the streets, in which a house-to-house visitation disclosed the fact that nearly every infant between two avenues had diarrhœa, and usually in a severe form, not a few dying. The street was compactly built with wooden tenement-houses on each side, and contained a dense population, mainly foreigners, poor, ignorant, and filthy in their habits. It had no sewer, and the refuse of the kitchens and bed-chambers was thrown into the street, where it accumulated in heaps. Water trickled down over the sidewalks from the houses into the gutters or was thrown out as slops, so that it kept up a constant moisture of the refuse matter which covered the street, and promoted the decay of the animal and vegetable substances which it contained. The air in the domiciles and street under such conditions of impurity was necessarily foul in the extreme, and stifling during the hot days and nights of July and August; and it was evidently the important factor in producing the numerous and severe diarrhœal cases which were in these domiciles.

In another locality, occupied by tripe-dealers and a low class of butchers who carried on fat- and bone-boiling at night, the air was so foul after dark that the peculiar impurity which tainted it could be distinctly noticed in the mouth for a considerable time after a night visit. In the street where these nuisances existed and in adjacent streets the summer diarrhœa was very prevalent and destructive to human life. Murchison states that 20 out of 25 boys were affected with purging and vomiting from inhaling the effluvia from the contents of an old drain near their school-room. Physicians are familiar with a similar fact showing this purgative effect of impure air—that the atmosphere of a dissecting-room often causes diarrhœa in those otherwise healthy.

The impurities in the air of a large city are very numerous. Among those of a gaseous natu [illegible] lphurous acid, sulphuric acid, sulphuretted hydro- [illegible] n; various [illegible], as carbonic acid, carburetted hydrogen, [illegible] car [illegible] trogen group, as the acetate, sulphide, [illegible] and nitric acids; and at times com- [illegible] Parkes). A theory deserving consider- [illegible] ties found in the air form purgative combinations. D. F. Lincoln, in his interesting paper on the atmosphere in the *Cyclopædia of Medicine*, writes in regard to sulphuretted hydrogen: "When in the air, freely exposed to the contact of oxygen, it becomes sulphuric acid. Sulphide of ammonium in the same circumstances becomes a sulphate, which, encountering common salt (chloride of sodium), produces sulphate of sodium and chloride of ammonium. The sulphates form a characteristic ingredient of the air in manufacturing districts." The sulphates, we know, are for the most part purgatives, but whether they or other chemical agents exist in the respired air in sufficient quantity to disturb the action of the intestines, even where atmospheric impurities are most abundant, is problematical and uncertain.

Again, the solid impurities in the air of a large city are very numerous, as any one may observe by viewing a sunbeam in a darkened room which is made visible by the numerous particles floating in it. These particles consist largely of organic matter, which sometimes has been carried a long distance by the wind. The remarkable statement has been made that in the air of Berlin organic forms have been found of African production. Ehrenberg discovered fragments of insects of various kinds—rhizopods, tardigrades, polygastrics, etc.—which, existing in considerable quantity and inhaled in hot weather when decomposition and fermentation are most active, may be deleterious to the system. Monads, bacteria, vibriones, amorphous dust containing spores which retain their vitality for months, are among the substances found in the air of cities. The well-known hazy appearance of the atmosphere resting over a large city like New York when viewed from a distance is due to the gaseous and solid impurities with which the air is so abundantly supplied—impurities which assume importance in pathological studies, since minute organisms are now believed to cause so many diseases the etiology of which has heretofore been obscure. There can be no reasonable doubt, from recent investigations, that the deleterious agents which cause the form of diarrhœa which we are considering are to a great extent bacteria, which find a soil most favorable for their propagation where the air as well as ingesta contains impurities. In foul air, as in the summer season, in the crowded parts of the city, and especially where decomposing animal and vegetable matter exists, the number of micro-organisms is vastly greater, as different observers have remarked, than in salubrious localities. Foul air and unwholesome food—food that has begun to undergo decomposition or that digests with difficulty, so that part of it ferments—afford the conditions which are eminently favorable for the development of pathogenic as well as non-pathogenic germs. We have seen that Booker and Vaughan have found bacteria in diarrhœal stools which when isolated by cultivation either kill or cause intestinal catarrh in animals experimented on, or the ptomaïnes produced by the bacteria have this effect. The evidence, therefore, is strong that bacteria are the chief causal agents of those forms of diarrhœa which originate from foul air and unwholesome and indigestible food.

In those portions of our cities which are occupied by the poor more than anywhere else those conditions prevail which render the atmosphere foul and unwholesome. One accustomed to the pure air of the country would scarcely believe how stifling and poisonous the atmosphere becomes during the hot summer days and close summer nights in and around the domiciles in the poor quarters of the city. Among the causes of this foul air may be men-
e a population, the occupancy of small rooms by large families,
and ceaseless endeavor to make ends meet, so that in the
est sanitary requirements are sadly neglected. Adults of such
nildren of both sexes as soon as they are old enough, engage
ten filthy occupations. Many of them seldom bathe, and

they often wear for days the same under-garments, foul with perspiration and dirt. The intemperate, vicious, and indolent, who always abound in the quarters of the city poor, are notoriously filthy in their habits and add to the insalubrity by their presence. Children old enough to be in the streets and adults away at their occupations escape to a great extent the evil effects of impure air, but the infantile population always suffer severely.

Every physician who has witnessed the summer diarrhœa of infants is aware of the fact that the mode of feeding has much to do with its occurrence. A large proportion of those who each summer fall victims to it would doubtless escape if the feeding were exactly proper. In New York City facts like the following are of common occurrence in the practice of all physicians: Infants under the age of eight months, if bottle-fed, nearly always contract diarrhœa, and usually of an obstinate character, during the summer months. The younger the infant, the less able is it to digest any other food than breast-milk, and the more liable is it therefore to suffer from diarrhœa if bottle-fed. In the institutions nearly every bottle-fed infant under the age of four or even six months dies in the hot months with symptoms of indigestion and intestinal catarrh, while the wet-nursed of the same ages remain well. Sudden weaning, the sudden substitution of cow's milk or an artificially prepared food in place of breast-milk in hot weather, almost always produces diarrhœa, often of a severe and fatal nature. Feeding an infant in the hot months with indigestible and improper food, as fruits with seeds or the ordinary table food prepared in such a way that it overtaxes the digestive function of the infant, causes diarrhœa, and not infrequently that severe form of it which will be described under the term cholera infantum. Many obstinate cases of the summer complaint begin to improve under change of diet, as by the substitution of one kind of milk for another or the return of the infant to the breast after it has been temporarily withdrawn from it. It is a common remark in the families of the city poor that the second summer is the period of greatest danger to infants. This increased liability of infants to contract diarrhœa in the second summer is due to the fact that most infants in their second year are table-fed, while in the first year they are wet-nursed. Such facts, with which all physicians are familiar, show how important the diet is as a factor in causing the summer complaint.

Occasionally, from continued ill-health, the milk of the mother or wet-nurse does not agree with the nursling. Examined with the microscope, it is found to contain colostrum. Under such circumstances if a healthy wet-nurse be employed the diarrhœa ceases. It is very important that any woman furnishing breast-milk to an infant should lead a quiet and regular life, with regular meals and sleep. R. B. Gilbert[1] relates striking cases in which venereal excesses on the part of wet-nurses were immediately followed by fatal diarrhœa in the infants whom they suckled.

One not a resident would scarcely be able to appreciate the difficulty which is experienced in a large city in obtaining proper diet for young children, especially those of such an age that they require milk as the basis of their food. Milk from cows stabled in the city or having a limited pasturage near the city, and fed upon a mixture of hay with garden and distillery products, the latter often largely predominating, is unsuitable. It is deficient in nutritive properties, prone to fermentation, and from microscopical and chemical examinations which have been made it appears that it often contains deleterious ingredients. If milk be obtained from distant farms, where pasturage is fresh and abundant—and in New York City this is the usual source of the supply—considerable time elapses before it is served to customers, so that, particularly in the hot months of July and August, it frequently has begun to undergo lactic-acid fermentation when the infants receive it. That dispensed to families in the morning is the milking of the previous morning and evening. The use of this milk in midsummer by infants under the age of ten months frequently gives rise to more or less diarrhœa.

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[1] *Louisville Med. Journal*, Aug. 19, 1882.

The ill-success of feeding with cow's milk has led to the preparation of various kinds of food which the shops contain, but no dietetic preparation has yet appeared which agrees so well with the digestive function of the infant as breast-milk, and is at the same time sufficiently nutritive.

In New York City improper diet, unaided by the conditions which hot weather produces, is a common cause of diarrhœa in young infants, for at all seasons we meet with this diarrhœa in infants who are bottle-fed; but when the atmospheric conditions of hot weather and the use of food unsuitable for the age of the infant are both present and operative, this diarrhœa so increases in frequency and severity that it is proper to designate it the summer epidemic of the cities. Several years since, before the New York Foundling Asylum was established, the foundlings of New York, more than a thousand annually, were taken to the almshouse on Blackwell's Island and consigned to the care of pauper-women, who were mostly old, infirm, and filthy in their habits and apparel. Their beds, in which the foundlings were also placed alongside of them, were seldom clean, not properly aired and washed, and under the beds were various garments and utensils which these pauper-women had brought with them as their sole property from their miserable abodes in the city. With such surroundings the air which these infants breathed day and night manifestly contained poisonous emanations, while their diet was equally improper, for it was prepared by these women from such milk and farinaceous food as were furnished the almshouse. When assigned to duty in the almshouse, this service being at that time a branch of Charity Hospital, I was informed that all the foundlings died before the age of two months; one only was pointed out as a curiosity which had been an exception to the rule. The disease of which they perished was diarrhœa, and this malady in the summer months was especially severe and rapidly fatal. The unpleasant experiences in this institution furnished additional evidence, were any wanting, that foul air and improper diet are the two important factors in causing the summer diarrhœa of infants. Since that beneficial charity, the New York Foundling Asylum, in East Sixty-eighth street, came into existence, providing pure air and, for a considerable proportion of the foundlings, breast-milk, many of these waifs have been rescued from death.

Age.—Age is a predisposing cause of diarrhæa, since most cases occur under the age of three years. A large majority of the summer diarrhœas of the cities occur under the age of two years. The following table embraces all the cases that came to one of the city dispensaries during my service between the months of May and October, inclusive:

Age.	Cases.
5 months or under	58
5 months to 12 months	212
12 months to 18 months	174
18 months to 24 months	93
24 months to 36 months	36
Total	573

Dentition.—Statistics show that by far the largest number of cases occur during the period of first dentition; hence the prevalent opinion among families that dentition causes the diarrhœa. It is the common belief among the poor of New York that diarrhœa occurring during dentition is conservative, and should not be checked. They believe that an infant cutting its teeth suffers less, and may be saved from serious illness, if it have frequent stools. Every summer I see infants reduced to a state of imminent danger through the continuance of diarrhœa during several weeks, nothing having been done to check it in consequence of this absurd belief. The progressive loss of flesh and strength and wasting of the features do not excite alarm, under the blinding influence of this theory, till the diarrhœa has continued so long and become so severe that it is with difficulty controlled, and the patient is in a state of real danger when the physician is first summoned. The following statistics, which comprise cases occurring during my service in one of the city dispensaries, show the preponderance of cases during the age when dental evolution is occurring:

	Cases.
No teeth and no marked turgescence of gums	47
Cutting incisors	106
Cutting anterior molars	41
Cutting canines	40
Cutting last molars	20
All the teeth cut	28
Total	282

It so happens that the period of dental evolution corresponds with that of the most rapid development and the greatest functional activity of the gastric and intestinal follicles, and the predisposition which exists to diarrhœal maladies at this age must be attributed to this cause rather than to dentition.

SYMPTOMS.—The intestinal catarrh of infancy commonly begins gradually with languor, fretfulness, and slight rise of temperature. The diarrhœa at first usually attracts little attention from its mildness. The stools, while they are thinner than natural, vary in appearance, being yellow, brown, or green. Infants with milk diet usually pass green and acid stools containing particles of indigested casein. The tongue in the commencement of the attack is moist and covered with a slight fur. At a more advanced stage it may be moist, but is often dry, and in dangerous forms of the malady, accompanied by prostration, the buccal surface is red and the gums more or less swollen and sometimes ulcerated. Vomiting is common. It may commence simultaneously with the diarrhœa, especially when food that is unusually indigestible and irritating to the stomach has been given, but more frequently this symptom does not appear until the diarrhœa has continued a few days. I preserved memoranda of the date when vomiting began in the cases treated in two consecutive years, and found that ordinarily it was toward the close of the first week. When it is an early and prominent symptom it appears to be due to the presence in the stomach of imperfectly digested or fermented and acid food, which, when ejected, gives a decidedly acid reaction with appropriate tests. It contains coagulated casein and undigested particles of whatever food has been given. In many patients the progressive loss of flesh and strength is largely due to the indigestion and vomiting, by which the food, which is so much required for proper nourishment, is lost.

Emesis occurring at a late stage of infantile diarrhœa is often due to commencing spurious hydrocephalus, which is not an infrequent complication, as we will see, of protracted cases. Perhaps when a late symptom it may sometimes have an uræmic origin, for the urine is usually quite scanty in advanced cases. It seems probable, however, that deleterious effects from non-elimination of urea are to a considerable extent prevented by the diarrhœa.

The fecal evacuations may remain nearly uniform in appearance during the disease, but in many patients they vary in color and consistence at different periods. In the same case they may be brown and offensive at one time, green at another, and again they may contain masses of a putty-like appearance, the partly-digested casein or altered epithelial cells. The stools sometimes consist largely of mucus, with or without occasional streaks of blood, indicating the predominance of inflammation in the colon. This is the mucous diarrhœa of Barrier. The stools are sometimes yellow when passed, but become green on exposure to the air from chemical reaction due to admixture with the urine, or to the agency of the microbe mentioned above that produces green coloring matter.

The character of the alvine discharges is interesting. In addition to undigested casein I have found epithelial cells, single or in clusters (sometimes regularly arranged as if detached in mass from the villi), fibres of meat, crystalline formations, mucus, and occasionally blood, as stated above. In one instance I observed an appearance resembling three or four crypts of Lieberkühn united, probably thrown off by ulceration. If the stools are green, colored masses of various sizes, but mostly small, are also seen under the microscope.

The pulse is accelerated according to the severity of the attack. The heat of the surface is at first generally increased, though but slightly in ordinary cases; but when the vital powers begin to fail from the continuance of the diarrhœa, the warmth of the surface diminishes. In advanced cases approaching a fatal termination the face and extremities are pallid and cool, and the pulse gradually becomes more frequent and feeble. The skin is usually dry, and, as already stated, the urinary secretion diminished. In severe cases attended by frequent alvine discharges the infant does not pass urine oftener than once or twice daily. The imperfect action of the skin and kidneys is noteworthy.

Protracted cases of diarrhœa are frequently complicated by two cutaneous eruptions—erythema extending over the perineum and frequently as far as the thighs and lower part of the abdomen, due to the acid and irritating character of the stools; and boils upon the forehead and scalp. The latter sometimes extend to the pericranium, and in case of recovery leave permanent cicatrices. This furuncular affection of the scalp has seemed to me useful in consequence of the external irritation which it causes, since it occurs at a time when, on account of the feeble heart's action and languid circulation, passive congestion of the vessels of the brain and meninges is liable to be present.

Patients who are weak and wasted in consequence of protracted diarrhœa, remaining almost constantly in the recumbent position, often have an occasional dry cough which continues till the close of life. It is due to hypostatic congestion in the lungs, usually limited to the posterior and inferior portions of the lobes, extending but a little way into the lungs. It is the result of prolonged recumbency with feeble heart's action and feeble pulmonary circulation. Infants reduced by chronic diseases, lying day after day in their cribs, with little movement of their bodies, are very liable to this passive congestion of depending portions of their lungs, toward which the blood gravitates, and into which but little air enters in consequence of their distance and position and the feeble respirations. The hyperæmia which results is of a passive character, a venous congestion, and the affected lobules have a dusky-red color. This congestion, continuing, soon results in pneumonia of the catarrhal form, subacute and of a low grade, for pulmonary lobules in which the blood remains stagnant soon exhibit augmented cell-proliferation, perhaps from the irritating effects of the elements of the blood now withdrawn from the circulation.

poor of New York that diarrhœa occurring during dentition is conservative, and should not be checked. They believe that an infant cutting its teeth suffers less, and may be saved from serious illness, if it have frequent stools. Every summer I see infants reduced to a state of imminent danger through the continuance of diarrhœa during several weeks, nothing having been done to check it in consequence of this absurd belief. The progressive loss of flesh and strength and wasting of the features do not excite alarm, under the blinding influence of this theory, till the diarrhœa has continued so long and become so severe that it is with difficulty controlled, and the patient is in a state of real danger when the physician is first summoned. The following statistics, which comprise cases occurring during my service in one of the city dispensaries, show the preponderance of cases during the age when dental evolution is occurring:

	Cases.
No teeth and no marked turgescence of gums	47
Cutting incisors	106
Cutting anterior molars	41
Cutting canines	40
Cutting last molars	20
All the teeth cut	28
Total	282

It so happens that the period of dental evolution corresponds with that of the most rapid development and the greatest functional activity of the gastric and intestinal follicles, and the predisposition which exists to diarrhœal maladies at this age must be attributed to this cause rather than to dentition.

SYMPTOMS.—The intestinal catarrh of infancy commonly begins gradually with languor, fretfulness, and slight rise of temperature. The diarrhœa at first usually attracts little attention from its mildness. The stools, while they are thinner than natural, vary in appearance, being yellow, brown, or green. Infants with milk diet usually pass green and acid stools containing particles of indigested casein. The tongue in the commencement of the attack is moist and covered with a slight fur. At a more advanced stage it may be moist, but is often dry, and in dangerous forms of the malady, accompanied by prostration, the buccal surface is red and the gums more or less swollen and sometimes ulcerated. Vomiting is common. It may commence simultaneously with the diarrhœa, especially when food that is unusually indigestible and irritating to the stomach has been given, but more frequently this symptom does not appear until the diarrhœa has continued a few days. I preserved memoranda of the date when vomiting began in the cases treated in two consecutive years, and found that ordinarily it was toward the close of the first week. When it is an early and prominent symptom it appears to be due to the presence in the stomach of imperfectly digested or fermented and acid food, which, when ejected, gives a decidedly acid reaction with appropriate tests. It contains coagulated casein and undigested particles of whatever food has been given. In many patients the progressive loss of flesh and strength is largely due to the indigestion and vomiting, by which the food, which is so much required for proper nourishment, is lost.

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I have made or procured a considerable number of microscopic examinations in these cases of hypostatic pneumonia, and the solidification of the pulmonary lobules has been found to be due to the exaggerated development of the epithelial cells in the alveoli, together with venous congestion. The affected lobules, whether in a stage of hypostatic congestion or the more advanced stage of hypostatic pneumonia, when examined at the autopsy were somewhat softer than in health, of dark color, and many of the lobules could be inflated by strong force of the breath; but in protracted cases the alveoli in central parts of the inflamed area resisted insufflation. The lung in hypostatic pneumonia, even when it is inflated, still feels firmer between the fingers than the normal lung.

Hypostatic pneumonia is so common in hospitals for infants that some physicians whose observations have been chiefly in such institutions have almost ignored other forms of pulmonary inflammation. Billard many years ago wrote: "The pneumonia of young children is evidently the result of stagnation of blood in their lungs. Under these circumstances the blood may be regarded as a kind of foreign body." Of all the chronic and exhausting diseases of infancy, no one has, according to my observations, been so frequently complicated by hypostatic pneumonia as the disease which we are considering, although it does not usually give rise to any more prominent symptom than an occasional cough. Limited to a small and almost immovable part of the lung, it does not ordinarily accelerate respiration or render it painful, and the cough is also apparently painless.

When the progressive loss of flesh and strength has continued several weeks and the patient is much exhausted, another complication is liable to occur, known as spurious hydrocephalus or the hydrocephaloid disease, the anatomical characters of which will be described in the proper place. The commencement of spurious hydrocephalus is announced by gradually increasing drowsiness, perhaps preceded by a period of fretfulness. Vomiting and rolling the head are occasional early symptoms of this complication. As the drowsiness increases the pupils become less sensitive to light than in their normal state, and are usually contracted. When the drowsiness becomes profound and constant the pupils remain contracted as in sound sleep or in opium narcotism. The functional activity of the organs is now also diminished, the vomiting ceases, the stools become less frequent, the buccal surface dry, and the urine scanty, while the pulse is frequent and feeble. Spurious hydrocephalus either continues till death or by stimulation the patient may emerge from it. When profound the usual result is death.

Although infantile diarrhœa in its commencement may be promptly arrested by proper hygienic and medicinal treatment, if it continue a few weeks the anatomical changes which occur are such that recovery, if it take place, is necessarily slow and gradual. Improvement is shown by better digestion, fewer stools and of better appearance, less frequent vomiting, a more cheerful countenance, and the absence of symptoms which indicate a complication. Many recover after days of anxious watching and perhaps after many fluctuations.

Death may occur early from a sudden aggravation of symptoms and rapid sinking, or the attack may be so violent from the first that the infant quickly succumbs; but more frequently death takes place after a prolonged sickness. Little by little the patient loses flesh and strength till a state of marked emaciation is reached. The eyes and cheeks are sunken, the bony projections of the face, trunk, and limbs become prominent, and the skin lies in wrinkles from the wasting. The altered expression of the face makes the patient look older than the actual age. The joints in contrast with the wasted extremities seem enlarged and the fingers and toes elongated. The stools diminish in frequency from diminished peristaltic and vermicular action, and vomiting, if previously present, now ceases. A feeble, quick, and scarcely appreciable pulse, slow respiration, and diminished inflation of the lungs, sightless and contracted pupils, over which the eyelids no longer close, announce the near approach of death. The drowsiness increases and the limbs become cool, while perhaps the head is hot. The infant no longer has the ability to nurse, or if bottle-fed the food placed in the mouth flows back or is swallowed with apparent indifference. So low is its vitality that it lies pallid and almost motionless for hours or even days before death, and death occurs so quietly that the moment of its occurrence is scarcely appreciable.

ANATOMICAL CHARACTERS.—Since the prominent and essential symptoms of the disease which we are considering pertain to the digestive apparatus, it is evident that the lesions which attend and characterize it are to be found in this part of the system. Lesions elsewhere, so far as they are appreciable to us, are secondary and not essential. I have witnessed a large number of autopsies of infants who have perished from diarrhœa, chiefly in institutions, and they have been sufficiently marked and uniform to enable us to designate it an entero-colitis. Several years since I preserved records of the autopsical appearances in the intestinal catarrh of infants, most of them being cases of summer diarrhœa. The number aggregated eighty-two. Since then I have witnessed many autopsies in institutions in cases of this disease, and the lesions observed were similar to those in the eighty-two cases.

The question may properly be asked, Can inflammatory hyperæmia of the intestinal mucous membrane be distinguished from simple congestion if there be no ulceration and no appreciable thickening of the intestine? It is possible that occasionally I have recorded as inflammatory what was simply a congestive lesion, but I do not think I have incorporated a sufficient number of such cases to vitiate the statistics. In a large proportion of the cases there was evident thickening of the intestinal mucous membrane or other unequivocal evidence of inflammation. The following is an analysis of the 82 cases: The duodenum and jejunum presented the appearance of inflammatory hyperæmia in 12 cases. The hyperæmia was usually in patches of variable extent or of that form described by the term arborescent. In 51 cases the duodenal and jejunal mucous membrane was pale and without any other appearance characteristic of catarrh or inflammation. In the remaining 19 cases the appearance of the duodenum and jejunum was not recorded, so that it was probably normal. On the other hand, in the ileum inflammatory lesions were present as a rule. In 49 cases I found the surface of the ileum distinctly hyperæmic, and in that portion of it nearest the ileocæcal valve, including the valve itself, the inflammation had evidently been the most intense, since in this portion the hyperæmia and thickening of the mucous membrane were most marked. In 16 cases the surface of the ileum appeared nearly or quite normal; in 14 hyperæmia in the small intestines in patches, streaks, or arborescence was recorded, but the records do not state in which division of the intestines they were observed.

Billard, with other observers, has noticed the frequency and intensity of the inflammatory lesions in entero-colitis in the terminal portion of the small intestines, and thickening in many cases of the ileo-cæcal valve, and he asks whether the vomiting which is so common and often obstinate in this disease may not be sometimes due to obstruction to the passage of fecal matter at the valve in consequence of its hyperæmia and swelling, but he has not observed any retained fecal matter above it, such as we find in any part of the colon, or any other appearance which indicated sufficient obstruction to cause symptoms. But it seems not improbable that the reason why the inflammatory lesions are more pronounced at and immediately above the valve than in other parts of the small intestine is that the fecal matter so commonly acid and irritating in this disease is somewhat delayed in its passage downward at this point.

Small superficial circular or oval ulcers were observed in the ileum in 4 cases, in 2 of which they were found also in the lower part of the jejunum. In 1 case the records state that ulcers were in the jejunum, but do not mention whether they were also in the ileum. In 1 case, in which there was much thickening of the ileum next to the ileo-caecal valve, many small granulations had sprouted up from the submucous connective tissue, so that the mucous surface appeared as if studded with small warts.

Softening of the mucous membrane was also apparent in certain cases. The firmness of its attachment to the parts underneath varied considerably in different specimens. I was able in cases in which there was considerable softening to detach readily the mucous membrane with the nail or handle of the scalpel within so short a period after death that it was probable that the change of consistence was not cadaveric. In some cases the vessels of the submucous tissue were injected and this tissue infiltrated.

In all the cases except one, lesions were present indicating inflammation of the mucous membrane of the colon. In 29 hyperaemia, thickening, and other signs of inflammation extended over nearly or quite the entire colon; in 14 the colitis was confined to the descending portion entirely or almost entirely; in 25 cases the records state that inflammatory lesions were found in the colon, but their exact location is not mentioned. In 15 of the autopsies the mucous membrane of the colon was found ulcerated.

Therefore, according to these statistics—and autopsies which I have witnessed that are not embraced in them disclosed similar lesions—colitis is present, almost without exception, in cases of summer diarrhœa, associated with more or less ileitis. The portion of the colon which presents the most marked inflammatory lesions is that in and immediately above the sigmoid flexure—that portion, therefore, in which any fermenting fecal matter has reached its greatest degree of fermentation, and consequently contains the most irritating elements, and where, next to the caput coli, it is longest delayed in its passage downward.

The solitary glands of both the large and small intestines and Peyer's patches undergo hyperplasia. In cases of short duration and in parts of the intestine where the inflammatory action has been mild, the solitary glands present a vascular appearance, like the surrounding membrane, and are slightly enlarged. The enlargement is most apparent if the intestine be viewed by transmitted light, when not only are the glands seen to be swollen, but their central dark points are distinct. If a higher grade of intestinal catarrh or a catarrh more protracted have occurred, the volume of these follicles is so increased that they rise above the common level and present a papillary appearance. Peyer's patches are also distinct and punctate. The enlargement of Peyer's patches, like that of the solitary glands, is due to hyperplasia, the elementary cells being largely increased in number.

The small ulcers which, as we have seen from the above statistics, are present in a certain proportion of cases in the mucous membrane of the colon, and more rarely in that of the small intestine when the inflammation has been protracted and of a severe type, appear to occur in the solitary glands and in the mucous membrane surrounding them. While some of these glands in a specimen are simply tumefied, others are slightly ulcerated, and others still nearly or quite destroyed. The ulcers are usually from one to three lines in diameter, circular or oval, with edges slightly raised from infiltration. Rarely, I have seen minute coagula of blood in one or more ulcers, and I have also observed ulcers which have evidently been larger and have partially healed. The ulcers are more frequently found in the descending colon than in other portions of the intestines. When ulcers are present they commonly occur in the descending colon, or if occurring elsewhere they are most abundant in this situation.

According to my observations, these ulcers are found chiefly in infants over the age of six months—during the time, therefore, when there is greatest functional activity and most rapid development of the solitary glands. Peyer's patches, though frequently prominent and distinct, have not been ulcerated in any of the cases observed by me.

The appendix vermiformis participates in the catarrh when it occurs in the caput coli, its mucous membrane being hyperæmic and thickened. In certain rare cases the inflammation is so intense that a thin film of fibrin is exuded in places upon the surface of the colon. It is liable to be overlooked or washed away in the examination. The rectum usually presents no inflammatory lesions, or but slight lesions in comparison with those in the colon. It remains of the normal pale color, or is but slightly vascular in most patients, even when there is almost general colitis. Hence the infrequency of tenesmus. If tenesmus be present, probably the rectum participates in the inflammation.

As might be expected from the nature of the disease, the secretion of mucus from the intestinal surface is augmented. It is often seen forming a layer upon the intestinal surface, and it appears in the stools mixed with epithelial cells and sometimes with blood and pus.

The mesenteric glands in cases which have run the most protracted course and ended fatally are found more or less enlarged from hyperplasia. They are frequently as large as a pea or larger, and of a light color, the color being due not only to the hyperplasia, but in part to the anæmia. Occasionally, when patients have been much reduced from the long continuance of diarrhœa, and are in a state of marked cachexia before death, we find certain of these glands caseous.

The state of the stomach is interesting, since indigestion and vomiting are so commonly present. I have records of its appearance in 59 cases, in 42 of which it seemed normal, having the usual pale color, and exhibiting only such changes as occur in the cadaver. In the remaining 17 cases the stomach was more or less hyperæmic, and in 3 of them points of ulceration were observed in the mucous membrane.

All physicians familiar with this disease have remarked the frequency of stomatitis. In protracted and grave cases it is a common complication. The buccal surface in these cases is more vascular than natural, and if the vital powers are much reduced superficial ulcerations are not infrequent, oftener upon the gums than elsewhere. The gums are frequently spongy, more or less swollen, bleeding readily when rubbed or pressed. Thrush is a common complication of protracted diarrhœa in infants under the age of three or four months, but is infrequent in older infants. Occurring in those over the age of six or eight months, it has an unfavorable prognostic significance, indicating a form of diarrhœa which commonly eventuates in death.

The belief has long been prevalent in the past that the liver is also in fault. The green color of the stools was supposed to be due to vitiated bile. But usually in the post-mortem examinations which I have made I have found that the green coloration of the fecal matter did not appear at the point where the bile enters the intestines, but at some point below the ductus communis choledochus, in the jejunum or ileum. The green tinge, at first slight, becomes more and more distinct on tracing it downward in the intestine. The manner in which it is produced has been treated of elsewhere.

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Nothing could be seen in these examinations which indicated any anatomical change in this organ that could be attributed to the diarrhœal malady. The size and weight of the liver varied considerably in infants of the same age, but probably there was no greater difference than usually obtains among glandular organs in a state of health. The following was the weight of this organ in 20 cases:

Age.	Weight.	Age.	Weight.
4 weeks	5 ounces.	10 months	6¾ ounces.
2 months	3½ "	13 "	6 "
2 "	3½ "	14 "	9 "
4 "	5 "	15 "	6 "
5 "	6½ "	15 "	7½ "
5 "	9 "	15 "	9½ "
7 "	4½ "	16 "	6 "
7 "	6 "	19 "	4½ "
7 "	6¼ "	20 "	9¼ "
9 "	8 "	23 "	15 "

In none of these cases did the size, weight, or appearance of this organ seem to be different from that in health or in other diseases, except in one in which fatty degeneration had occurred, but this was probably due to tuberculosis, which was also present. In most of these cases the liver was examined microscopically, and the only noteworthy appearance observed was the variable amount of oil-globules in the hepatic cells. In some specimens the oil-globules were in excess, in others deficient, and in others still they were more abundant in one part of the organ than in another. Little importance was attached to these differences in the quantity of oily matter.

Hypostatic congestion of the posterior portions of the lungs, ending if it continue in a form of subacute catarrhal pneumonia and giving rise to an occasional painless cough, has been described in the preceding pages. The character of the cough in connection with the wasting might excite suspicions of the presence of tubercles in the lungs; but tubercles are rare in this disease, and when present I should suspect a strong hereditary predisposition. They occurred in only 1 of the 82 cases.

The state of the encephalon in those patients in whom spurious hydrocephalus occurs is interesting. In protracted cases of diarrhœa the brain wastes like the body and limbs. In the young infant, in whom the cranial bones are still ununited, the occipital and sometimes the frontal bones become depressed and overlapped by the parietal, the depression being of course proportionate to the diminution in size of the encephalon. The cranium becomes quite uneven. In other children, with the cranial bones consolidated, serous effusion occurs according to the degree of waste, thus preserving the size of the encephalon. The effusion is chiefly external to the brain, lying over the convolutions from the base to the vertex. Its quantity varies from one or two drachms to an ounce or more. Along with this serous effusion, and antedating it, passive congestion of the cerebral veins and sinuses is also present. This congestion is the obvious and necessary result of the feebleness of the heart's action and the loss of brain-substance.

DIAGNOSIS.—In the adult, abdominal tenderness is an important diagnostic symptom of intestinal catarrh, but in the infant this symptom is lacking or is not in general appreciable, so that it does not aid in diagnosis. When the diagnosis of the disease is established, the symptoms do not usually indicate what part of the intestinal surface is chiefly involved, but it may be assumed that it is the lower part of the ileum and the colon. The presence of mucus or of mucus tinged with blood in the stools shows the predominance of colitis.

PROGNOSIS.—Although this disease largely increases the death-rate of young children, most cases can be cured if proper hygienic and medicinal measures be early applied. It is obvious, from what has been stated in the foregoing pages, that cholera infantum is the form of this malady which involves greatest danger. Except in such cases there is sufficient forewarning of a fatal result, for if death occur it is after a lingering sickness, with fluctuations and gradual loss of flesh and strength. Patients often recover from a state of great prostration and emaciation, provided that no fatal complications arise. The eyes may be sunken, the skin lie in folds from the wasting, the strength may be so exhausted that any other than the recumbent position is impossible, and yet the patient may recover by removal to the country, by change of weather, or by the use of better diet and remedies. Therefore an absolutely unfavorable prognosis should not be made except in cases that are complicated or that border on collapse. The most dangerous symptoms, except those which indicate commencing or actual collapse, arise from the state of the brain. Rolling the head, squinting, feeble action or permanent contraction of the pupils, spasmodic or irregular movements of the limbs, indicate the near approach of death, as do also coldness of face and extremities and inability to swallow. It is obvious also, in making the prognosis in ordinary cases, that we should consider the age of the patient, and if the diarrhœa be that of the summer season, the state of the weather, the time in the summer, whether in the beginning or near its close, and the surroundings, especially in reference to the impurity of the air, as well as the patient's condition.

CHOLERA INFANTUM, OR CHOLERIFORM DIARRHŒA.

This is the most severe form of infantile diarrhœa. It receives the name which designates it from the violence of its symptoms, which closely resemble those of Asiatic cholera. It is, however, quite distinct from that disease. It is characterized by frequent stools, vomiting, great elevation of temperature, and rapid and great emaciation and loss of strength. It commonly occurs under the age of two years. It sometimes begins abruptly, the previous health having been good; in other cases it is preceded by the ordinary form of diarrhœa. The stools have been thinner than natural and somewhat more frequent, but not such as to excite alarm, when suddenly they become more frequent and watery, and the parents are surprised and frightened by the rapid sinking and real danger of the infant.

The first evacuations, unless there have been previous diarrhœa, may contain fecal matter, but subsequently they are so thin that they soak into the diaper like urine, and in some cases they scarcely produce more of a stain than does this secretion. Their odor is peculiar—not fecal, but musty and offensive; occasionally they are almost odorless. Commencing simultaneously with the watery evacuations or soon after is another symptom—irritability of the stomach, which increases greatly the prostration and danger. Whatever drinks are swallowed by the infant are rejected immediately or after a few moments, or retching may occur without vomiting. The appetite is lost and the thirst is intense. Cold water is taken with avidity, and if the infant nurse it eagerly seizes the breast in order to relieve the thirst. The tongue is moist at first, and clean or covered with a light fur, pulse accelerated, respiration either natural or somewhat increased in frequency, and the surface warm, but its temperature is speedily reduced in severe cases. The internal temperature or that of the blood is always very high. In ordinary cases of cholera infantum the thermometer introduced into the rectum rises to or above 105°, and I have seen it indicate 107°. Although the infant may be restless at first, it does not appear to have any abdominal pain or tenderness. The restlessness is apparently due to thirst or to that unpleasant sensation which the sick feel when the vital powers are rapidly reduced. The urine is scanty in proportion to the gravity of the attack, as it ordinarily is when the stools are frequent and watery.

The emaciation and loss of strength are more rapid than in any other disease which I can recall to mind, unless in Asiatic cholera. In a few hours the parents scarcely recognize in the changed and melancholy aspect of the infant any resemblance to the features which it previously exhibited. The eyes are sunken, the eyelids and lips are permanently open from the feeble contractile power of the muscles which close them, while the loss of the fluids from the tissues and the emaciation are such that the bony angles become more prominent and the skin in places lies in folds.

As the disease approaches a fatal termination, which often occurs in two or three days, the infant remains quiet, not disturbed even by the flies which alight upon its face. The limbs and face become cool, the eyes bleared, pupils contracted, and the urine scanty or suppressed. In some instances, when the patient is near death, the respiration becomes accelerated, either from the effect of the disease upon the respiratory centres or from pulmonary congestion resulting from the feeble circulation. As the vital powers fail the pulse becomes progressively more feeble, the surface has a clammy coldness, the contracted pupils no longer respond to light, and the stupor deepens, from which it is impossible to arouse the infant.

In the more favorable cases cholera infantum is checked before the occurrence of these grave symptoms, and often in cases which are ultimately fatal there is not such a speedy termination of the malady as is indicated in the above description. The choleriform diarrhœa abates and the case becomes one of the ordinary summer complaint.

ANATOMICAL CHARACTERS.—Rilliet and Barthez, who of foreign writers treat of cholera infantum at greatest length, describe it under the name of gastro-intestinal choleriform catarrh. "The perusal," they remark, "of anatomico-pathological descriptions, and especially the study of the facts, show that the gastro-intestinal tube in subjects who succumb to this disease may be in four different states: (*a*) either the stomach is softened without any lesion of the digestive tube; (*b*) or the stomach is softened at the same time that the mucous membrane of the intestine, and especially its follicular apparatus, is diseased; (*c*) or the stomach is healthy, while the follicular apparatus or the mucous membrane is diseased; (*d*) or, finally, the gastro-intestinal tube is not the seat of any lesion appreciable to our senses in the present state of our knowledge, or it presents lesions so insignificant that they are not sufficient to explain the gravity of the symptoms.

"So far, the disease resembles all the catarrhs, but what is special is the abundance of serous secretion and the disturbance of the great sympathetic nerve.

"The serous secretion, which appears to be produced by a perspiration (analogous to that of the respiratory passages and of the skin) rather than by a follicular secretion, shows, perhaps, that the elimination of substances is effected by other organs than the follicles; perhaps, also, we ought to see a proof that the materials to eliminate are not the same as in simple catarrh. Upon all these points we are constrained to remain in doubt. We content ourselves with pointing out the fact."[1]

On the 1st of August, 1861, I made the autopsy of an infant sixteen months old which died of cholera infantum with a sickness of less than one day. The examination was made thirty hours after death. Nothing unusual was observed in the brain, unless perhaps a little more than the ordinary injection of vessels at the vertex. No marked anatomical change was observed in the stomach and intestines, except enlargement of the patches of Peyer as well as of the solitary and mesenteric glands. Mucous membrane pale. In this and the following cases there was apparently slight softening of the intestinal mucous membrane, but whether it was pathological or cadaveric was uncertain, as the weather was very warm. The liver seemed healthy. Examined by the microscope, it was found to contain about the normal number of oil-globules.

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[1] *Maladies des Enfants.*

The second case was that of an infant seven months old, wet-nursed, who died July 26, 1862, after a sickness also of about one day. He was previously emaciated, but without any marked ailment. The post-mortem examination was made on the 28th. The brain was somewhat softer than natural, but otherwise healthy. There was no abnormal vascularity of the membranes of the brain, and no serous effusion within the cranium. The mucous membrane of the intestines had nearly the normal color throughout, but it seemed somewhat thickened and softened; the solitary glands of the colon were prominent. The patches of Peyer were not distinct.

In the New York Protestant Episcopal Orphan Asylum an infant twenty months old, previously healthy, was seized with cholera infantum on the 25th of June, 1864. The alvine evacuations, as is usual with this disease, were frequent and watery and attended by obstinate vomiting. Death occurred in slight spasms in thirty-six hours. The exciting cause was probably the use of a few currants which were eaten in a cake the day before, some of which fruit was contained in the first evacuations. The brain was not examined. The only pathological changes which were observed in the stomach and intestines were slightly vascular patches in the small intestines and an unusual prominence of the solitary glands in the colon. The glands resembled small beads imbedded in the mucous membrane. The lungs in the above cases were healthy, excepting hypostatic congestion.

Since the date of these autopsies I have made others in cases which terminated fatally after a brief duration, and have uniformly found similar lesions—to wit, the gastro-intestinal surface either without vascularity or scantily vascular in streaks or patches, sometimes presenting a whitish or soggy appearance and somewhat softened, while the solitary glands were enlarged so as to be prominent upon the surface. In cases which continue longer evident inflammatory lesions soon appear which are identical with those which have already been described in our remarks relating to the ordinary form of diarrhœa.

During my term of service in the New York Foundling Asylum in the summer of 1884 an infant died after a brief illness with all the symptoms of cholera infantum, and the intestines were sent to William H. Welch, now of Johns Hopkins Hospital, for microscopic examination. His report was as follows: "I found undoubted evidence of acute inflammation. There was an increased number of small round cells (leucocytes) in the mucous and submucous coats. This accumulation of new cells was most abundant in and around the solitary follicles, which were greatly swollen. Clumps of lymphoid cells were found extending even a little into the muscular coat. The epithelial lining of the intestine was not demonstrable, but this is usually the case with post-mortem specimens of human intestine, and justifies no inferences as to pathological changes. The glands of Lieberkühn were rich in the so-called goblet-cells, and some of the glands were distended with mucus and desquamated epithelium, so as to present sometimes the appearance of little cysts. This was observed especially in the neighborhood of the solitary follicles. The blood-vessels, especially the veins of the submucous coat, were abnormally distended with blood. I searched for micro-organisms, and found them in abundance upon the free surface of the intestine, in mucous accumulations there, and also in the mouths of the glands of Lieberkühn. Both rod-shaped and small round bacteria were found. I attach no especial importance to finding bacteria upon the surface of the intestine. The general result of the examination is to confirm the view that cholera infantum is characterized by an acute intestinal inflammation."

NATURE.—Cholera infantum appears from its symptoms and lesions to be the most severe form of intestinal catarrh to which infants are liable. The alvine discharges, to which the rapid prostration is largely due, probably consist in part of intestinal secretions, and in part of serum which has transuded from the capillaries of the intestines. That the intestinal mucous membrane sometimes presents a pale appearance at the autopsy of an infant who, previously well, has died of cholera infantum after a sickness of twenty-four or forty-eight hours, is perhaps due to the great amount of liquid secretion and transudation in which the inflamed surface is bathed. Moreover, it is, I believe, a recognized fact that the hyperæmia of an acutely inflamed surface when of short duration frequently disappears in the cadaver, as that of scarlet fever and erysipelas. The early hyperplasia of the solitary and mesenteric glands, and the hyperæmia and thickening of the surface of the ileum and colon in those who have survived a few days, affords additional proof of the inflammatory character of the malady.

The opinion has been expressed by certain observers that cholera infantum is identical with thermic fever or sunstroke. There is indeed a resemblance to thermic fever as regards certain important symptoms. In cholera infantum the temperature is from 105° to 108°; in sunstroke it is also very high, often running above 108°. Great heat of head, contracted pupils, thin fecal evacuations, embarrassed respiration, scanty urine, and cerebral symptoms are common toward the close of cholera infantum, and they are the prominent symptoms in sunstroke. Nevertheless, I cannot accept the theory which regards these maladies as identical, and which removes cholera infantum from the list of intestinal diseases. In cholera infantum the gastro-intestinal symptoms always take the precedence, and are, except in advanced cases, always more prominent than other symptoms. It does not commence as by a stroke like *coup de soleil*, but it comes on more gradually, though rapidly, and it often supervenes upon a diarrhœa or some error of diet. In the commencement of cholera infantum the infant is usually not drowsy, and is often wide awake and restless from the thirst. Contrast this with the alarming stupor of sunstroke. Sunstroke only occurs during the hours of excessive heat, but cholera infantum may occur at any hour or in any day during the hot weather, provided that there be sufficient dietetic cause. Again, intestinal inflammation is not common in sunstroke, while it is the common, or, as I believe, the essential, lesion of cholera infantum. These facts show, in my opinion, that the two maladies are essentially and entirely distinct. Nevertheless, cases of apparent sunstroke sometimes occur in the infant, and if the bowels are at the same time relaxed the disease may be regarded as cholera infantum, and if fatal is usually reported as such to the health authorities. Cases of this kind I have occasionally observed or they have been reported to me, although they are not common.

With the exception of the organs of digestion no uniform lesions are observed in any of the viscera in cholera infantum, except such as are due to change in the quantity and fluidity of the blood and its circulation. Writers describe an anæmic appearance of the thoracic and abdominal viscera, and occasionally passive congestion of the cerebral vessels. The cerebral symptoms usually present toward the close of life in unfavorable cases of cholera infantum are often due to spurious hydrocephalus, which we have described above; but as the urinary secretion is scanty or suppressed, cerebral symptoms may in certain cases be due to uræmia.

Diagnosis.—This form of the summer diarrhœa is diagnosticated by the symptoms, and especially by the frequency and character of the stools. The stools have already been described as frequent, often passed with considerable force, deficient in fecal matter, and thin, so as to soak into the diaper almost like urine. The vomiting, thirst, rapid sinking, and emaciation serve to distinguish cholera infantum from other diarrhœal maladies.

When Asiatic cholera is prevalent the differential diagnosis between the two is difficult if not impossible.

Prognosis.—Cholera infantum is one of those diseases in regard to which physicians often injure their reputation by not giving sufficient notice of the danger, or even by expressing a favorable opinion when the case soon after ends fatally. A favorable prognosis should seldom be expressed without qualification. If the urgent symptoms be relieved, still the disease may continue as an ordinary intestinal inflammation, which in hot weather is formidable and often fatal. If the stools become more consistent and less frequent without the occurrence of cerebral symptoms, while the limbs are warm and the pulse good, we may confidently express the opinion that there is no present danger.

The duration of true cholera infantum is short. It either ends fatally, or it begins soon to abate and ceases, or it continues and is not to be distinguished in its subsequent course from an attack of summer diarrhœa beginning in the ordinary manner.

Treatment of Infantile Diarrhœa.—Obviously, efficient preventive measures consist in the removal of infants so far as practicable from the operation of the causes which produce the disease. Weaning just before or in the hot weather should, if possible, be avoided, and removal to the country should be recommended, especially for those who are deprived of breast-milk during the age when such nutriment is required. If for any reason it is necessary to employ artificial feeding for infants under the age of ten months, that food should obviously be used which most closely resembles human milk in digestibility and in nutritive properties.

It is also very important that the infant receive its food in proper quantity and at proper intervals, for if the mother or nurse in her anxiety to have it thrive feed it too often or in too large quantity, the surplus food which it cannot digest, if not vomited, undergoes fermentation, and consequently becomes irritating to the gastro-intestinal surface. The physician should be able to give advice not only in reference to the frequency of feeding, but also in regard to the quantity of food which the infant requires at each feeding. Correct knowledge and advice in this matter aid in the prevention and cure of the diarrhœal maladies of infancy. The reader is referred to the chapters relating to the feeding of infants.

The indications for treatment are: 1st. To provide the best possible food which will afford sufficient nutriment and be easily digested; 2d. To aid the digestive functions of the infant; 3d. To employ such medicinal agents as can be safely given to check the diarrhœa and cure the intestinal catarrh; 4th. To procure fresh air, which is especially needed if the diarrhœa be that of the summer season.

We will here repeat certain facts in reference to the feeding of infants which are of the highest importance in the treatment of the diarrhœal maladies. Milk designed for the nursery should always be sterilized by the action of heat at or a little below the boiling-point, prolonged from one to two hours. I uniformly direct that the morning supply of milk designed for the infant be as soon as received placed in or over water in a steamer or other suitable vessel and subjected to a heat at or a little below 212° during two hours. This milk is used during the following twenty-four hours. Barley or wheat flour, subjected to the prolonged action of heat, by which its starch is changed more or less into dextrin, is also required. By the proper admixture of the farinaceous food with the milk the best possible diet for the bottle-fed infant will be obtained. The reader is referred to the appropriate chapters for details relating to infant feeding.

The infant with intestinal catarrh, the prominent symptom of which is diarrhœa, is thirsty, and is therefore likely to take more nutriment in the liquid form than it requires for its sustenance. If wet-nursed it craves the breast, or if weaned it craves the bottle at short intervals. No more nutriment should be allowed than is required for nutrition, and the thirst may be best relieved by a little cold water, to which the white of egg is added, gum-water, or thin barley-water, containing a few drops of whiskey or brandy.

In the dietetic treatment of the summer diarrhœa of the bottle-fed infant, in which not only diarrhœa but indigestion and vomiting are prominent symptoms, I at first withhold cow's milk and allow only barley gruel, the barley flour having been previously subjected to the heat of boiling water seven days. If the infant exhibit evidences of innutrition, I add to the gruel designed for each feeding, when it is cool, the white of a fresh egg, the mixture containing sufficient salt to be tasted, and usually two to three drops of whiskey or brandy for each month of the infant's age. The feeding should be at intervals of three hours. This food should be at a temperature not higher than 50° or 60° F., on account of the egg, and the infant readily takes it in consequence of the thirst if not from hunger. If it craves drink or more nutriment between the feedings, take one-third of a tumblerful of water previously boiled and its temperature reduced to 40° or 50°, and add to it the white of the egg, with a little brandy. The infant will take this readily, and if old enough to speak will ask for more. It is a good vehicle for the powder of bismuth and pepsin. With this diet the infant is sufficiently nourished for a week or more. At present (August, 1890) an infant whom I am attending takes the white of eight eggs in twenty-four hours. In a few days, when the vomiting and to a certain extent the diarrhœa are controlled, milk, previously sterilized by heat and peptonized by peptogenic powder, may be cautiously added to the barley gruel in place of the egg—three tablespoonfuls for a child of five months, and five or six tablespoonfuls for one of twelve months.

The occasional cases of infantile diarrhœa which result from taking cold require to be treated by the use of bland and easily-digested diet, and medicines that are soothing and such as restrain the evacuations and relieve pain; prominent among which remedies are bismuth and an opiate. But a large majority of the cases of diarrhœa in infancy arise, as we have seen, from improper feeding and insanitary conditions, and to these cases the following remarks apply. The summer diarrhœal epidemics of the cities especially demand our attention on account of the large number that are affected and the many deaths that result.

We have seen that the two factors which produce the microbic diarrhœa of infancy, of which the summer epidemic of the cities is the type, are improper food and foul air. It is therefore obvious that measures should be employed to render the atmosphere in which the infant lives as free as possible from noxious effluvia. Cleanliness of the person, of the bedding, and of the house in which the patient resides, the prompt removal of all refuse animal or vegetable matter, whether within or around the premises, and allowing the infant to remain a considerable part of the day in shaded localities where the air is pure, as in the parks or suburbs of the city, are important measures. In New York great benefit has resulted from the floating hospital which every second day during the heated term carries a thousand sick children from the stifling air of the tenement-houses down the bay and out to the fresh air of the ocean.

But it is difficult to obtain an atmosphere that is entirely pure in a large city with its many sources of insalubrity; and all physicians of experience agree in the propriety of sending infants affected with the summer diarrhœa to localities in the country which are free from malaria and sparsely inhabited, in order that they may obtain the benefits of purer air. Many are the instances each summer in New York City of infants removed to the country with intestinal inflammation, with features haggard and shrunken, with limbs shrivelled and the skin lying in folds, too weak to raise (or at least hold) their heads from the pillow, vomiting nearly all the nutriment taken, with stools frequent and thin, resulting in great part from molecular disintegration of the tissues—presenting, indeed, an appearance seldom observed in any other disease except in the last stages of phthisis—and returning in late autumn with the cheerfulness, vigor, rotundity of health. The localities usually preferred by the physicians of this city are the elevated portions of New Jersey and Northern Pennsylvania, the Highlands of the Hudson, the central and northern parts of New York State, and Northern New England. Taken to a salubrious locality and properly fed, the infant soon begins to improve if the disease be still recent, unless it be exceptionally severe. If the disease have continued several weeks at the time of the removal, little benefit may be observed from the country residence until two or more weeks have elapsed.

An infant weakened and wasted by the summer diarrhœa, removed to a cool locality in the country, should be warmly dressed and kept indoor when the heavy night dew is falling. Patients sometimes become worse from injudicious exposure of this kind, the intestinal catarrh from which they are suffering being aggravated by taking cold and perhaps rendered dysenteric.

Sometimes parents, not noticing the immediate improvement which they have been led to expect, return to the city without giving the country fair trial, and the life of the infant is then, as a rule, sacrificed. Returned to the foul air of the city while the weather is still warm, it sinks rapidly from an aggravation of the malady. Occasionally, the change from one rural locality to another, like the change from one wet-nurse to another, has a salutary effect. The infant, although it has recovered, should not be brought back while the weather is still warm. One attack of the disease does not diminish, but increases, the liability to a second seizure.

Medicinal Treatment.—*Opiates.*—It is evident that opiates are less used than formerly in the treatment of the microbic diarrhœas of infancy. A proper appreciation of the pathology of these diarrhœas naturally leads to the belief that the opiates are less important as curative agents than they were formerly supposed to be. Opiates diminish the peristalsis and the number of stools, but they do not destroy the microbes or the ptomaïnes. Their use should, I think, be limited to cases of restlessness, of tenesmus, and of frequent watery stools. They may be useful in controlling symptoms till other remedies have time to act. One drop of laudanum or fifteen drops of paregoric may be given to an infant of ten months and repeated in three hours. I prefer paregoric to any other opiate in the treatment of the summer diarrhœas of infancy, since they are attended by marked prostration, and this agent is highly stimulating, from the camphor which it contains.

Antiseptics.—Although the pathology of microbic diarrhœa suggests the use of antiseptics, my observations have not been favorable to the use of salol, naphthaline, or corrosive sublimate. They have seemed to me to do more harm than good. Guaita employs sodium benzoate. He administers in twenty-four hours one drachm or a drachm and a half in three ounces of water, with, it is stated, good results.[1] The antiseptic which is more largely used than any other, and which more than any other has the confidence of the profession—and justly so—is the subnitrate of bismuth. It undergoes a chemical change in the stomach and intestines, becoming a bismuth sulphide and causing dark stools. It may be combined with chalk or pepsin, and should be given in doses of ten or twelve grains to an infant of six months.

Irrigation of the Stomach.—Physicians of experience in New York and elsewhere recommend irrigation of the stomach with warm water in the treatment of malnutrition and gastro-intestinal catarrh. It removes from the stomach thick curds that digest with difficulty, as well as other aliment that may be undergoing gastric digestion. It has not, perhaps, been sufficiently employed to determine its full value, but from what I have seen of its effects I am not able to recommend it. The nutriment should be given so prepared and with such aids to digestion that the heavy casein curds do not form in the stomach. Moreover, the gastric juice is the one of the digestive ferments that is especially destructive to microbes, so that it is needed in the stomach for its germicide as well as digestive action. We have seen from the observations of Dr. Max Einhart that after two hours the stomach digestion of properly prepared milk or milk and barley gruel is completed, and the stomach in a state to receive more food. For these reasons irrigation of the stomach, habitually practised even in cases of indigestion or catarrh, seems to me more likely to be injurious than beneficial. On the other hand, when the stools are fermenting and imperfectly digested, and are accompanied by tenesmus, irrigation of the rectum frequently gives considerable relief.

Alkalies.—Acids, especially the lactic and butyric products of faulty digestion, often collect in the stomach and intestines. These acids, which are active irritants, should be neutralized while we endeavor to prevent their production by improving the diet and aiding the digestion. In a few days the inflammatory irritation of the mucous follicles causes an exaggerated secretion of mucus, which is alkaline, and which neutralizes the acids to a considerable extent. An alkali is therefore required in most cases. It is especially useful when the infant has acid vomiting and acid stools. Lime-water, the sodium bicarbonate, and the various preparations of chalk are the antacids which by common consent are employed to neutralize the acids in the diarrhœal maladies of infancy. My preference is for the mistura cretæ, given midway between the nursings or feedings. An alkali is incompatible with pepsin, and as pepsin preparations are needed to assist digestion, they should not be given at the same time with the alkali.

ASTRINGENTS.—The vegetable astringents were formerly much used in the treatment of the diarrhœal diseases of infancy, but they are now seldom prescribed for these cases. Even the mineral astringents, acetate of lead and nitrate of silver, have gone out of use in the treatment of the infantile diarrhœas. The alkalis and bismuth have taken their place.

Stimulants.—The diarrhœa, if severe, soon produces symptoms of prostration or heart failure, so that alcoholic stimulation is needed. Brandy or whiskey is the best stimulant in this disease—from ten to twenty-five drops according to the age every second hour.

Occasionally it is proper to commence the treatment by the employment of some gentle purgative, especially when the diarrhœa begins abruptly after the use of irritating and indigestible food. A single dose of castor oil or syrup of rhubarb, or the two mixed, will remove the irritating substance, and afterward remedies designed to control the disease can be more successfully employed.

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[1] *N. Y. Med. Record*, May 31, 1884.

The following are useful prescriptions:

℞. Bismuth. subnitrat., ʒij;
Mistura cretæ, ℥ij. Misce.

Shake thoroughly, and give one teaspoonful every two hours to an infant of six to ten months. It should be administered midway between the feedings, for the reason stated above.

℞. Bismuth. subnitrat., ʒij;
Mucil. acaciæ, ℥ss;
Aquæ cinnamomi, ʒiss. Misce.

Shake bottle, and give one teaspoonful hourly until the vomiting and diarrhœa cease.

Some physicians of large experience, as Prof. Henoch of Berlin, recommend small doses of calomel, as a twelfth or twentieth of a grain three or four times daily. If it be useful it probably acts as a germicide, but we have, it seems to me, more efficient and safer remedies, and I never prescribe it.

It is very important in the treatment of the summer diarrhœa to aid digestion while we employ an antiseptic, and the following are formulæ which I have employed with apparently the best results in family practice and in the institutions in New York:

℞. Acidi hydrochlorici dil., ♏xvj;
Pepsini puri, in lamellis, ʒj;
Bismuthi subnitrat., ʒij;
Syrupi, fʒij;
Aquæ, fʒxiv. Misce.

Shake bottle. Give one teaspoonful before each feeding or nursing to an infant of ten months; half a teaspoonful to an infant of five months.

℞. Pepsini saccharati, ʒi–ij;
Bismuthi subnitrat., ʒij. Misce.

Divide in chart. No. xii. Give one powder before each nursing or feeding to an infant of ten months.

℞. Pepsini puri, in lamellis, ʒj;
Bismuthi subnitrat., ℥ss:
Vini pepsini, N. F., ℥ss;
Aquæ destillat., ℥iiiss. Misce.

Shake bottle. Give one teaspoonful before each feeding to an infant at or above the age of six months; half a teaspoonful between the ages of two and six months.

℞. Pepsini puri, in lamellis, ʒj;
Bismuthi subnitrat., ℥ss. Misce.

Give as much as goes on a ten-cent piece or a five-cent nickel piece before each nursing or feeding.

If the diarrhœa and vomiting have ceased, but the digestion be slow and incomplete, the following prescriptions will be found useful:

℞. Pepsini puri, in lamellis, ʒj;
Lactopeptone, ℥ss.

Give as much as will go on a ten-cent piece or as much as will cover a nickel five-cent piece before each feeding.

℞. Pepsini puri, in lamellis, ʒj;
Vini pepsini, N. F., ℥ss;
Aquæ destillat., ℥iiiss. Misce.

Give half a teaspoonful to one teaspoonful, according to the age, before each feeding.

If cerebral symptoms appear, as rolling the head, drowsiness, etc., indicating the commencement of spurious hydrocephalus, an alcoholic stimulant, as whiskey or brandy, is required; and although there may be, at times, great restlessness, explicit and positive directions should be given to withhold opiates if they have been previously employed. One of the bromides, with an alcoholic stimulant or the aniseed cordial of the National Formulary, to allay restlessness, would be the proper remedy in addition to bismuth and pepsin if symptoms of heart failure or spurious hydrocephalus occur.

In protracted cases, when the vital powers begin to fail, as indicated by pallor, more or less emaciation, and loss of strength, the following tonic will sometimes be useful in restraining the diarrhœa and increasing the appetite and strength. It should not be prescribed until the diarrhœa has assumed a subacute or chronic character:

℞. Tinct. columbæ, f℥iij;
Liq. ferri nitratis, ♏xxvij;
Syr. simplic., ℥j;
Aquæ, ℥ij. Misce.

Dose: One teaspoonful every three or four hours to an infant of one year.

External Treatment.—In the gastro-intestinal catarrh of the cool months, produced by exposure to cold, light and mildly stimulating applications over the abdomen are sometimes useful, as a light poultice of flaxseed to which one-sixteenth or one-twentieth part of mustard is added, or a poultice of cloves, cinnamon, and ginger, or even camphorated oil, on the under surface of a flaxseed poultice, covered with oil-silk. But in those forms of gastro-intestinal catarrh due to improper feeding or insanitary conditions, and having a bacterial origin, external measures are commonly useless, and in the summer months they might do injury by increasing the warmth.

CHAPTER IX.

ENTERITIS AND COLITIS IN CHILDHOOD.

INTESTINAL inflammation in childhood differs materially from the form or type which it commonly presents in infancy. Its causes, symptoms, and extent vary in important particulars in the two periods. In childhood there is not ordinarily such extensive inflammation of the mucous membrane of the intestines as we have seen is present in the majority of cases in infancy, and it may therefore be properly treated as two diseases, according to the seat of the morbid process—to wit, enteritis and colitis. Both these affections in childhood resemble so closely the form which they exhibit in adult life that no extended description is needed in this connection.

CAUSES.—A main cause is sudden reduction of temperature by exposure to cold or to currents of air, which checks perspiration and causes determination of blood from the surface to the viscera. These inflammations are also caused sometimes by irritating substances in the intestines. I have known fecal accumulations, as well as worms, to produce severe dysentery in the child, accompanied by the characteristic tenesmus and muco-sanguineous stools, and ceasing as soon as the offending substances were expelled. The use of unripe or stale vegetables, if there be a strong predisposition to mucous inflammation, may be a sufficient cause, and some of the most dangerous cases are due to the accumulation in the intestines of seeds and the parenchyma of fruits. But the most common cause is that mentioned—to wit, sudden exposure to cold when the body is heated, a danger to which children are especially liable on account of the easy disturbance of the circulatory system in them, and their heedless exposure of themselves unless incessantly watched. Enteritis and colitis are also frequently secondary diseases occurring in childhood as complications or sequelæ of the eruptive fevers, especially measles.

SYMPTOMS.—The alvine discharges in enteritis and colitis in childhood are such as occur in these diseases at a more advanced age. In enteritis they are thin and of the natural color, or occasionally green; in colitis they are more consistent than in enteritis and are largely muco-sanguineous. Sometimes in enteritis, if the inflammation be not intense, the diarrhœa is slow in appearing, or it may be slight, so as not to attract special attention. The disease may then resemble remittent fever, for which it is at times mistaken. The upper part of the small intestines is less frequently affected than the lower. If there be duodenitis, the flow of bile is occasionally impeded from tumefaction of the mouth of the common bile-duct, and the icteric hue appears. In both enteritis and colitis there is abdominal tenderness, with more or less constant pain if the disease be severe, and in colitis tormina and tenesmus. The pulse is accelerated, the heat of surface augmented, the face flushed and, except in mild cases, expressive of pain. In many children at the commencement of the inflammation the nervous system is profoundly affected, as indicated by headache, stupor, twitching of the limbs, and sometimes by convulsions. The chief danger at the commencement of the disease is, indeed, from this source. Sometimes irritability of the stomach occurs and the food is rejected, though much less frequently than in the intestinal inflammation of infancy. Anorexia and thirst are common symptoms. If the inflammation continue there is soon perceptible emaciation, with loss of strength. The eyes become hollow, the face pallid, and the surface cool. Death may occur at an early period, the vital powers succumbing from the intensity of the inflammation. In other cases the acute disease ends in a subacute or chronic inflammation; the patient becomes gradually more reduced, till he dies in a state of extreme emaciation, such as we often observe in the entero-colitis of infancy; or from this state he may recover by degrees, though perhaps with an irritable state of the bowels, which continues for months. In a majority of cases, however, enteritis and colitis in childhood, if properly treated, soon begin to yield, and they terminate favorably in one or two weeks.

DIAGNOSIS.—It is not difficult to determine the existence of the inflammation. This is indicated by the fever, abdominal tenderness, and the relaxed state of the bowels. Whether the disease be enteritis or colitis is determined by the character of the stools, the seat of the tenderness, and the presence or absence of tenesmus.

PROGNOSIS.—It has been stated above that enteritis and colitis in children commonly terminate favorably. The result depends not only on the extent and severity of the inflammation, but the constitution and previous health. The inflammation is more serious when secondary than when primary. Extensive and great tenderness of the abdomen, features pallid, anxious, and expressive of suffering, pulse frequent and feeble, should excite the most serious apprehensions. Frequent vomiting also denotes a grave form of the disease. Stupor, and especially convulsive movements, show that the nervous centres are affected, and should make us guarded in the prognosis. Improvement in the disease on which to base a favorable prediction is apparent in the diminution of the tenderness, improvement in the pulse and character of the stools, a more cheerful countenance, and less disrelish of food.

TREATMENT.—This should be similar to that employed for the adult. In enteritis at the commencement of the disease, if there be reason to suspect the presence of any irritating substance in the intestines, and ordinarily in colitis, it is advisable to commence treatment by the use of some simple evacuant, like castor oil. After this our reliance, so far as internal treatment is concerned, must be mainly on opiates and antiphlogistic medicines. One of the best remedies of this class is the Dover's powder, which may be given to a child five years old in doses of three grains every three hours. A corresponding dose of any of the other opiates may be given, but with less sudorific effect. In colitis the occasional administration of a laxative should not be neglected if the stools be entirely or mainly muco-sanguineous. It should be employed so as to prevent accumulation of fecal matters in the colon, which would serve as an irritant and increase the inflammation. The dose should be small, merely sufficient to produce fecal evacuation, and repeated as required, daily or less frequently. The laxatives commonly preferred are magnesia, rhubarb, or castor oil. The physician may prescribe an opiate mixture containing sufficient of the laxative to have the effect desired, though ordinarily it is better to prescribe the two separately, so that the laxative can be given or withheld according to circumstances, while the opiate is continued more regularly. Except that there be some irritating substance which requires removal the effect of laxatives is injurious instead of beneficial. Instead of a laxative given by the mouth, the use of a clyster of glycerin and sweet oil in tepid water is often preferable. The following prescriptions may be employed for a child of five years:

℞. Pulv. opii, gr. v;
Bismuth. subnitrat., ʒij. Misce.

Divid. in pulveres No. xx. Give one powder every two to four hours.

℞. Pulv. ipecac. comp., ʒj;
Bismuth. subnitrat., ʒij. Misce.

Divid. in pulveres No. xxiv. Give one powder as above.

℞. Tinc. opii deodorat., ʒss;
Bismuth. subnitrat., ʒij;
Aq. menth. piperit.,
Syr. zingiberis, *āā*. ℥j. Misce.

Shake bottle. Give one teaspoonful from two to four hours.

The local treatment which is found most beneficial consists in the use of emollient applications covered with oil-silk, and made sufficiently irritating by mustard or otherwise to cause constant redness.

The diet should be bland and unirritating. In the first stage of the inflammation rice or barley-water or arrowroot boiled in water and similar drinks should constitute the main diet. When the active inflammation has abated, and at any period of the disease if there be a tendency to prostration, more nourishing food should be given. Milk and animal broths may then be allowed. In cases which are protracted or attended with symptoms of exhaustion alcoholic stimulants are required.

CHAPTER X.

CONSTIPATION.

THE gastro-intestinal portion of the digestive apparatus has a double function. First, it receives and retains the food during the process of digestion; it furnishes the most important of the liquids by which digestion is effected; and it absorbs those products of digestion which are required for the nutrition of the body, while it serves as a barrier against the admission of refuse matter. Secondly, it has an excretory function, so that a large part of the waste and noxious products of the system are eliminated from its surface. Having, therefore, a relation so close and fundamental to the general nutrition, it is necessary, for the normal activity of the organs and the maintenance of health, that its functions be regularly and fully performed. But retention of fecal matter beyond the normal period is one of the most common ailments both in infancy and childhood, and occasionally it constitutes a grave disease. The reader is referred to page 155 for remarks relating to constipation of the newly-born.

Constipation is of two kinds—namely, *symptomatic* and *idiopathic*.

Symptomatic Constipation.—CAUSES.—Many of these are obstructive. The more common of them are the following: (*a*) *Congenital stenosis*, or occlusion of the anus or rectum. The anus is not formed or it terminates in a cul-de-sac, while the lower end of the large intestine forms another cul-de-sac. These two cul-de-sacs, lying opposite to each other, one looking upward and the other downward, may be separated from each other by a small interspace, a fibrous septum, so that relief can be obtained by a puncture or incision, or they may be widely separated, so that there is no possible mode of relief, and death is inevitable unless the fecal matter escape through a congenital fistulous passage upon one of the adjacent mucous surfaces; which mode of relief was present in 40 per cent. of the cases of this obstruction collected by Leichtenstern. Exceptionally, this malformation occurs in the sigmoid flexure, while the rectum is normal. The stenosis, if slight, may produce little delay in the evacuations, except when hardened masses or coarse, indigestible substances descend upon it, and it may therefore with careful selection of diet, cause little inconvenience for a lengthened period, while much stenosis causes early obstructive symptoms.

Rarely the stenosis is at the ileo-cæcal orifice. (See page 155.)

(*b*) *Intestinal Displacements.*—These produce obstructions of a very painful and dangerous kind. Intussusception and external hernia are too well known to require description. Both are likely to produce complete obstruction if not soon relieved, but there are cases of intussusception in children in which the displaced intestine remains pervious, and the evacuations occur with more or less regularity; and the same is true of one form of hernia—namely, the congenital—which, although painful, seldom produces serious obstruction.

Painful and dangerous occlusion and consequent arrest of alvine evacuations occasionally result from the imprisonment of a loop of intestine in an opening, usually congenital, in the mesentery or diaphragm, or from the knotting of one portion of intestine with another, as described by Leichtenstern, or again from the twisting of the intestine. Epstein and Soyka[1] relate the case of a new-born infant that died in the second week after birth with symptoms of obstruction. At the autopsy a portion of the small intestine with its mesentery was found twisted upon its axis from right to left, without any marked evidence of inflammation.

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[1] *Centralb. f. d. med. Wissensch.*, April 24, 1879.

(*c*) Substances which have been swallowed or substances whose nuclei have been swallowed, and which consist of a deposit of carbonate and phosphate of lime, or substances which have been produced entirely in the system, and which, lodged in narrow parts of the intestine, cause obstruction. Such substances, some of which occur most frequently in children and others in elderly people, produce acute constipation. Indigestible matter contained in the food, as seeds or the parenchymatous portions of fruits, occasionally collects in considerable quantity and obstructs the intestine. A large gall-stone having escaped from the common bile-duct, sometimes lodges in the intestine, either at the ileo-cæcal valve or more rarely at some other point, and retards the passage of fecal matter. But this seldom occurs in children. In one instance, and in only one, have I known obstinate constipation to be produced by worms. The patient was a girl of about four years, in whom constipation came on suddenly, and was accompanied by distension of abdomen and great suffering. This continued nearly one week, when a mass of intertwined round worms was expelled, with immediate relief. The records of medicine also contain cases in which neoplasms, growing from the coats of the intestines internally, have attained such a size as to retard the evacuations.

(*d*) *Abscesses and tumors*, especially when occurring in the pelvis, also sometimes cause constipation by pressing upon the intestine and obstructing or narrowing the passage through it. Thus, in 1868, Mr. Thomas Smith related to the London Pathological Society the case of an infant, aged fourteen months, in whom both alvine and urinary evacuations were retarded by a cancerous tumor growing between the rectum and bladder, and ending fatally in three months after the occurrence of the first symptoms.

(*e*) *Peritonitis*, during its continuance, is known to constipate the bowels. It is supposed that inflammatory œdema occurs around the muscular fibres of the middle coat, by which their contractility is impaired. Hence the lax state, the meteorism, and inaction of the intestines in this disease. When the peritonitis abates the normal action is restored and the evacuations occur regularly if the free surface of the peritoneum have undergone no unfavorable change. But, unfortunately, peritonitis often produces more lasting injury, so as to interfere seriously with the intestinal movements and produce an habitually torpid state of the bowels. This occurs from adventitious bands of inflammatory origin which lie across the intestines, compressing them at the points of contact and restraining their movements, and from adhesion of the intestinal loops.

The most marked cases which I have observed of this were children who had had tubercular peritonitis. The following was an interesting example:

CASE.—Charles, aged four years, was returned to the New York Foundling Asylum on April 16, 1877, to be treated for tumor albus of the left knee and for general ill-health. His parentage and early history were unknown. The nurse in the city to whom he had been entrusted when quite small stated that he had no sickness when with her except sore eyes, and that about April 1, 1877, the enlargement of the knee was first observed. The head of the boy was large and the abdomen much distended, but without any decided tenderness on pressure; its entire lower part had a purplish color. Percussion over it gave a dull sound, except upon and near the epigastrium, where there was some resonance; umbilicus prominent; circumference of body over abdomen, twenty-three inches; pulse 128; axillary temperature 99°. It was stated that he had no stool without medicine, and that usually one tablespoonful of castor oil was required to produce it.

The urine contained no albumen and was apparently normal. As the appearance indicated struma, a mixture of cod-liver oil, syrup of the lactophosphate of lime, and iron was prescribed, to be given three times daily, and directions were given to rub cod-liver oil over the abdomen also three times each day for five minutes each time. Some nodules were felt on pressure upon the abdomen, which we suspected were enlarged mesenteric glands. From the day on which the friction and kneading of the abdomen were commenced the stools began to occur, on the average, about twice daily. The kneading proved the safest, as well as most efficient, method of producing defecation.

On May 4th the circumference of the trunk over the most prominent part of the abdomen was reduced to twenty-two inches. The records on May 11th state: "Same treatment is continued; has tolerable appetite, but is pallid, and his flesh flabby and soft." On May 22d the circumference of the trunk gave twenty-two and three-quarter inches. The tumor albus remained about the same.

I saw the patient again during attendance in the asylum in August and November. The record in November states that he is feeble and failing; is becoming weaker and thinner; breath and exhalations from the surface offensive; he is kept quiet on account of the knee. From this time he gradually failed, and died April 11, 1878. There was no cough to attract attention, and instead of constipation a diarrhœa of some weeks' continuance preceded death.

Autopsy.—Lungs healthy, except a little exudation over the summit of right lung; bronchial glands cheesy; numerous tubercles, some of them cheesy, upon the parietal and visceral surface of the peritoneum. Loops of the intestines were united to each other by old adhesions, and the small intestines were generally bound down by bands into a "uniform conglomeration;" mesenteric glands enlarged and cheesy; a large ulcer upon the surface of the rectum, and numerous small round ulcers upon the surface of small and large intestines, apparently occupying the site of the solitary follicles.

Occasionally a false band, the result of peritonitis, lies across the intestines, without restraining their movements and producing no marked symptoms, and probably no symptoms at all, until a loop happens to pass underneath it, when, if not soon released, it is liable to become strangulated, with complete obstruction to the passage of fecal matter. This displacement might properly be classified with the internal hernias described above. In my own person at the age of twelve years such an accident occurred about two months after the peritonitis. Upon the abatement of the inflammation a sensation of traction had been noticed in the umbilical region almost daily during exercise, and the displacement was indicated by the extreme pain which characterizes such cases, and which ceased suddenly when the parts were released after about eighteen hours.

(*f*) While it is important that the diet and glandular secretions should be such that the feculent matter may have proper consistence for easy propulsion along the intestinal tube, the important agent by which alvine evacuations are effected is obviously muscular contraction. The muscular fibres of the intestines produce the vermicular and peristaltic movements by which the excrement is carried forward, and the abdominal muscles by their powerful contraction are the chief agents of expulsion. Now, any pathological state which impairs the innervation of these muscles or renders it abnormal, destroying the proper balance between "exciting and inhibiting impulses," is likely to cause constipation. Hence meningitis, myelitis, and certain other diseases of the cerebro-spinal axis, rachitis, general weakness, etc., are commonly attended by a sluggish state of the intestines, either from tonic contraction of the muscular fibres of the middle coat, as in meningitis or from paralysis.

Idiopathic Constipation.—CAUSES.—These are quite numerous. The more prominent of them are the following: First, too little liquid in the excrement, so that it is too firm for ready evacuation. There may be too little liquid taken in the ingesta or too scanty secretion of the liquids which mix with the food, as those of the pancreas, liver, and mucous follicles, or there may be too great an absorption of liquid through the coats of the intestines, and too active an excretion of water from the skin, kidneys, or lung. The firmer the fecal matter the greater the tendency to constipation. Those who lose a large amount of water, as in diabetes, night sweats, or from occupations which expose to heat or from residence in a hot climate, are especially liable to constipation, except as the loss of liquid is compensated by an increased amount of drink.

The character of the food, apart from the amount of liquid which it contains, obviously has a marked influence upon the consistence and frequency of the stools. Occasionally, the intestines act sluggishly from insufficiency of food. Thus, the infant sometimes hangs an unusually long time on the breast, and the mother or wet-nurse believes it to be a hearty nurser, when there is really a deficiency of milk, and the stools are scanty and infrequent from lack of material. Again, constipation is not uncommon in infants who nurse heartily and seem to obtain a sufficient quantity of milk, and the cause of it is not in the state of the digestive organs, but in the milk. We find that now and then breast-milk has a constipating effect, although we discover nothing to cause this result in the mother's diet or health. The comparison of ordinary milk with colostrum may furnish a clew to the explanation. Colostrum is known to be more laxative than ordinary milk, and it differs from it chemically in containing more butter, sugar, and salts. Hence the theory seems plausible that when breast-milk is constipating these elements occur in less than the normal quantity. And we shall see hereafter that treatment suggested by this theory obviates the constipation.

The use of a diet which consists chiefly of assimilable substances, as animal food, and from which, after the digestive process, little coarse and stimulating residuum remains, is obviously liable to produce a sluggish state of the bowels. On the other hand, coarse food, as fruits with their seeds, coarsely-ground meal, etc., which stimulates the peristaltic action and the secretions, increases the number and frequency of the alvine discharges.

Habit also exerts a decided influence upon defecation. One who, for whatever reason, neglects or resists the desire for a stool soon becomes less conscious of the daily recurring need and establishes a constipated habit. Constipation is more liable to occur in those who lead a quiet life than in those who are active. A constipated habit is established in many school-children by neglecting or repressing the desire for a stool during school hours.

But there are cases in which there seems to be a constitutional tendency to constipation—a tendency quite independent of the usual conditions. Thus I have met children who were bright and active, free from obstruction or disease which might retard the evacuations, apparently far from having sluggish muscular contractility, and, so far as I could see, with proper diet, and yet with defecation, except as it was produced by measures employed, occurring no oftener than each second, third, or fourth day.

But it must be borne in mind that what is constipation in one child may not be in another, for occasionally one does well with only one evacuation every second or third day, while a large majority require daily defecation in order to the maintenance of perfect health.

In the adult the sacculi or pouches which occur in the walls of the colon, produced by contraction of the longitudinal bands acting at right angles to the direction of the circular fibres, and consisting of the internal and external tunics without the muscular, become the receptacles for fecal matter in those who are constipated, and obviously tend to increase the constipation. In children these sacculi are much less developed relatively, and in young infants, whose intestines lack the longitudinal bands, are absent, so that this anatomical condition by which the passage of fecal matter is delayed, is unimportant as a cause of constipation in the young.

On page 157 we have stated that Gautier of Geneva, Switzerland, has called attention to an anal fissure as a cause of constipation in the newly-born and in older children. The constipation occurs from the endeavor to resist defecation on account of the pain.

We have also remarked on page 157 that constipation has a tendency to perpetuate itself, since retained feculent matter becomes more consistent and firmer, and the contractile power of the muscular tunic becomes weakened by long distension. Obviously, also, an abnormal length of the large intestine, so that it doubles on itself, whether congenital or the result of constipation, and a malposition which diminishes the space occupied by the colon, and therefore increases its flexures, have a tendency to produce constipation.

SYMPTOMS.—When there is a mechanical cause which retards the passage of fecal matter the acuteness of symptoms and the suffering are generally proportionate to the degree of obstruction. Symptomatic constipation occurring in an obstructive disease, whether adhesions, peritoneal bands, intussusception, knots or twisting of the intestine, incarceration in a false passage, or from biliary or intestinal stones or fecal masses, is attended by severe symptoms, such as intense colicky pain, vomiting, loss of appetite, and rapid prostration. The ingesta accumulate above the point of obstruction, producing distension of the intestine with fecal matter and gas, while below the point of obstruction the intestine is soon empty. The symptoms indeed have the severity and the state involves the danger present in ordinary strangulated hernia, while, from being internal, and therefore less accessible for treatment, the danger is even greater. If the intestinal tract be narrowed, whether by a false ligament, the result of an old peritonitis, or other cause, and there be still perviousness, so that excrementitious matter passes by the obstruction, though slowly and with more or less difficulty, the patient may be comparatively comfortable if the food be such that no hard masses remain; but according to the degree of stenosis and the amount and coarseness of the fecal matter symptoms occur referable to the obstruction. If the excrement be propelled with difficulty through the narrowed part, the muscular coat above the obstruction gradually becomes more developed from hypertrophy of the muscular fibres, just as the heart enlarges from obstructive disease of its valves, while below the obstruction the intestine atrophies and its calibre diminishes from disuse. Colicky pains, accumulation of fecal matter above the obstruction, distension of abdomen, eructation of gas, vomiting, impaired appetite, and consequent decline of the general health are common results. There is constant danger in these cases that the narrow passage may become obstructed by fecal matter if it happen to contain hard masses or coarse indigestible substances. The gravest form of constipation is obviously that due to mechanical agencies which act as obstacles, but as the obstacles are numerous, differently located, and of different character, so there is great difference in the gravity of the cases.

Idiopathic constipation generally comes on gradually. It at first attracts little attention and is neglected. The symptoms of course vary greatly according to the degree and stage of constipation. In mild cases the retention is only in the rectum or rectum and sigmoid flexure, and there are no marked symptoms except a sensation of fulness or distension of these parts, which one or two evacuations relieve. Between these mild cases and the graver forms of constipation there is every intermediate grade, attended by symptoms proportionately severe. It is surprising sometimes to observe how long patients live with extreme constipation, though with constant suffering and ill-health; and—which I wish especially to be noticed in this connection

—a large proportion of the fatal cases of idiopathic constipation occurring in adults and recorded in the literature of the profession began in early life, even in infancy, at which time they probably might have been relieved by proper remedies and a life of suffering prevented. This important practical fact shows the need of greater attention on the part of parents and nurses to the state of the bowels in children, that their sluggish action may be corrected before it becomes habitual and those anatomical changes of distension and muscular paralysis occur which are with difficulty corrected.

A case quite remarkable and of recent date occurred in the practice of Dr. Strong[1] of Westfield, N. Y.:

CASE.—This patient at the age of two years usually had one stool in two weeks, and several years later only one in six weeks. When an adult he was treated by Dr. Strong, who found great distension of the abdomen, so that the lower ribs were pressed outward in nearly a horizontal direction, and the thoracic organs upward, so that the apex-beat of the heart was about one inch above the nipple. At this time months elapsed between the stools, the longest intervals being eighteen months and sixteen days. Defecation when it did occur lasted from two to four days, and was attended by violent gastric and intestinal pain, vomiting, and prostration. At one of these prolonged stools forty pounds of feces, resembling, as it usually did, chewed brown paper, were evacuated, the quantity being accurately ascertained by weighing the patient before and afterward. He had appetite and was able to do certain kinds of farm-work during the year preceding his death, which occurred at the age of twenty-eight years. At the autopsy the colon was found to have a length of six feet and three inches and a circumference of thirteen inches, while the lungs were pressed upward and backward as when compressed by a pleuritic exudation.

While such extreme cases are infrequent, all physicians of experience are consulted from time to time by adults who have had habitual constipation from their earliest recollection; and these cases, that aggregate so large a number, might, there is little reason to doubt, have been prevented for the most part during childhood when the habit was being formed.

In long-continued constipation, in which there is a large fecal accumulation, not only is the diameter of the colon increased, as stated above, but this part of the intestine becomes elongated. This may lead to change in its position, the curves of the sigmoid flexure extending farther to the right, and the central part of the transverse colon by its weight curving downward. This abnormal lengthening and the consequent curvatures have a tendency to increase the constipation, as has been stated above in our remarks relating to the etiology.

In these cases of extreme constipation, which fortunately are rare in children, as they are also in adults, the distension of the colon at the ileo-cæcal orifice has a tendency to widen this orifice, so that the valve, which in the ordinary state prevents the return of any substance which has once passed by it, is liable to become insufficient. The adjacent folds which constitute the valve become separated, so that, if vomiting and antiperistaltic movements occur, fecal matter may pass from the colon toward the stomach. In aggravated cases, in which there is retention of a large amount of fecal matter, distension, muscular paralysis, etc., similar to those which we have seen produced in the colon, are liable to occur, though to a less extent, in the small intestines, especially in the ileum.

Retained excrementitious matter accumulating in large masses evidently becomes an irritant, so that by its pressure it excites muscular contractions, which if ineffectual in propelling the mass cause colicky pains. The retained fecal matter also undergoes more or less decomposition, producing gases which by increasing the distension also increase the pain.

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[1] *Amer. Jour. of Med. Sci.*, 1874 and 1876.

Any irritating substance applied to a mucous surface is liable to excite increased secretion from the mucous follicles or from the glands whose orifices connect with the mucous membrane at the point of irritation. Many familiar examples will at once be recalled to mind, as the defluxion from the nostrils from the use of snuffs and increased mucous secretion and salivation from objects held in the mouth. In the same way, retained excrement, forming hard masses which press upon the intestinal surface, excite a secretion, and not infrequently produce thereby a diarrhœa which is conservative, and which may for the time unload the bowels, or it may remove a part of the scybalæ, while the rest remain. Hence we sometimes hear patients speak of having irregular evacuations, constipation alternating with diarrhœa. In aggravated cases the pressure of impacted feces sometimes produces inflammation of the surface, when, in addition to abdominal pain, there are tenderness on pressure and some (usually quite moderate) elevation of temperature. In cases which have terminated fatally after a longer or shorter time, destruction of the mucous surface has been found in places in consequence of the pressure and inflammation. We can readily believe that, as in cases of typhoid ulcerations, if the ulcers reach a certain depth they may also give rise to localized peritonitis, and that occasionally perforation may result at the ulcerated or gangrenous point. The expulsion of hardened masses which have collected in the rectum is slow and painful, and accompanied by more or less tenesmus, which not infrequently causes a portion of the mucous membrane at the anal orifice to descend below the sphincter ani and protrude, by which hemorrhoids are produced. Occasionally, as I have observed in certain cases, the entire circumference of the rectal mucous membrane, to the distance of half an inch or more above the anus, becomes so loosened from its attachment to the connective tissue that it descends below the sphincter ani and protrudes during each defecation. But this displacement, known as prolapsus recti, more commonly results in children from protracted intestinal catarrh, attended by diarrhœa, loss of flesh, and by diminished tonicity of the tissues.

A beautiful and conservative provision in the system is that by which vicarious functions are established to relieve organs which imperfectly perform their part. While the intestinal surface is to a great degree eliminative, so that noxious and effete products are largely expelled from the system in the stools, it possesses also in high degree an absorbent function, as all who employ rectal alimentation are aware. Now, if the intestine fail to perform its function of defecation and feculent matter collect within it and begin to exert pressure upon the intestinal surface, more or less of the liquid portion is taken up by the vessels, and, entering the general circulation, finds a mode of escape through other emunctories. The general ill-health or languor, the furred tongue, headache, and foul breath which characterize these cases are, no doubt, due to the absorption into the blood or retention in it of noxious products contained in, and which in part constitute, the feculent matter. The fact that patients may live for years with tolerable appetite, and with only one dejection every second or third week, receives explanation in the fact that other organs, as the lungs, kidneys, skin, etc., act as depurants for such excrementitious matter as can be taken up in a liquid or gaseous form by the intestinal surface.

In infants, constipation, even when slight and temporary, often causes fretfulness, which is indicated by the character of their cries and the movement of the thighs over the abdomen. Continuing for a time, it causes more or less fever, and in those young children who are liable to eclampsia it predisposes to an attack, and it may be the chief cause.

Treatment.—If there be reason to suspect the presence of a mechanical obstacle which prevents normal defecation, a careful examination should be made in order to discover, if possible, its nature and location. Often it is of such a nature that it cannot be removed, but its constipating effects may sometimes be in a measure obviated. In one of the published cases in which constipation continued from early childhood to adult life, and finally proved fatal, its cause was ascertained to be a septum in the rectum, which probably might have been relieved by surgical measures. In all cases of constipation which the history shows may be produced by mechanical causes, whether the obstruction be complete and the colicky pains and other symptoms severe, or there be occasional scanty evacuations with but slight or moderate suffering, the history of the patient should be obtained in order to ascertain if there had been at any previous time symptoms of peritonitis or other pathological state which might throw light on the etiology. The abdomen and the usual sites of hernia should be carefully explored by palpation, and the rectum by the finger, large-sized catheter, or rectal tube. A thorough examination thus instituted, painless to the patient, will usually enable the practitioner to determine either the exact or probable obstacle if any be present.

The proper treatment of symptomatic constipation obviously requires the removal, so far as possible, of the primary disease or the cause, whether it be obstructive or otherwise. We need not stop to consider the special measures which are required, and will pass to the consideration of the treatment of idiopathic constipation.

Hygienic Measures.—We have already alluded to the fact that habit has a powerful control over the action of the intestines, so that it is important to obtain a daily alvine evacuation at a certain hour, and by establishing the habit the need will usually be experienced when that hour arrives each day. Many cases which become troublesome and obstinate might no doubt have been prevented had this physiological law been heeded and a daily evacuation obtained at a certain hour. The constipated habit, mild and not yet fully established, is more liable to be overlooked when it occurs in childhood than in infancy, for the infant is closely and constantly under observation, and it soon presents symptoms, as fever and fretfulness, if it do not have the regular evacuation, while children over the age of four or five years tolerate better a sluggish state of the bowels, and are likely to be constipated for a considerable time before it is ascertained. They therefore require more attention in this regard than is usually bestowed by parents.

The nature of the diet is obviously important, as certain kinds of food are more laxative than others. Chicken tea and, to a certain extent, beef and mutton tea, are laxative, and made plainly are therefore useful in connection with other articles. The various kinds of berries and fruits have also a decidedly stimulating effect on the intestinal surface and aid in removing constipation. The apple scraped or baked, or apple sauce, may be given to quite young children; and for those that are older currants, cherries, and, among dry fruits, prunes and figs, are laxative. Unfermented cider in its season, which has been found so useful for adults, may also be given to children in moderate quantity, at least to those who have reached the age of two or three years.

By the digestive process starch, which is unassimilable, is changed into grape-sugar, which can be absorbed and assimilated, and from the small size of the salivary glands in the first months of infancy it is believed that the salivary and pancreatic fluids are insufficient to convert starch into grape-sugar except in very inadequate quantity. It appears, however, highly probable that there is an epithelial ferment which converts starch into sugar,[1] so that young infants can digest starchy food in limited quantity. The belief that the infantile digestion up to a certain age is inadequate to effect the change led to the preparation of food for infants in which the change of starch into grape-sugar was accomplished by a chemical process. Now, grape-sugar, given in considerable quantity, is laxative, and I have found it necessary to give it sparingly and with other food in the hot months, when infants are prone to diarrhœa. But this laxative effect renders the glucose preparations of the shops very useful in the treatment of habitual constipation of infants, whether we employ the "maltose" or "granulated sugar of malt" or the preparations of Liebig's food. Of four constipated infants in the New York Infant Asylum to whom Horlick's "sugar of malt" was given, three were relieved. Any of the glucose preparations can be given quite freely to a constipated infant without impairing the digestive function or producing other ill-effect, so long as no more than the normal evacuations are produced; and I consider them among the best and safest of the foods for the relief of constipation in infants; but glucose or grape-sugar is only feebly laxative, probably not more than cane-sugar.

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[1] "Chemical Phenomena of Digestion," by Charles Richet, *Rev. des Sci. méd.*, Oct., 1878.

Oatmeal is more laxative than most other kinds of amylaceous food. Made into a gruel and strained, it may be given to the nursing infant, and unstrained to those who are older. Bread or pudding from coarsely-ground or unbolted flour or meal, and vegetables which contain saline and fibrous substances, have a stimulating and laxative effect on the surface of the intestines, and therefore are useful for constipated children of the age of two or three years and upward.

There can be no doubt that the free use of water in the ingesta materially aids in relieving costiveness. In one of the numbers of the London *Lancet* a physician asks the profession how to cure obstinate constipation in adults. Among the replies, one physician suggests drinking a tumblerful of cold water on retiring to bed and another tumblerful in the morning; and there can, I think, be little doubt that the laxative effect of broths, gruels, fruits, and mineral waters is partly due to the amount of water which they contain. One of the chief causes of constipation, we have seen, is too great firmness or consistence of the stools, due to absorption of the water; and if a larger quantity of water be swallowed during or after the meals than is removed by absorption, so that the stools have their normal or less than normal consistence, this cause of constipation is removed. An excess of water introduced into the system is to a great extent eliminated by the kidneys, and in hot weather by the skin, and to a certain extent exhaled from the lungs; but experience shows that if the amount of liquid received be so great that the vessels in the coats of the intestines continue in a state of repletion, only a certain part of it is absorbed, while the rest descends and mixes with the excrementitious matter.

The simple expedient of allowing a liberal use of water, so useful in adult cases, doubtless also has a laxative effect in children, and its judicious use is proper for them. Another important aid in overcoming habitual constipation is frequent kneading of the abdomen. My attention was first particularly directed to this in the treatment of the case related above, in which obstinate constipation, occurring in a child of three years from peritoneal bands and adhesions, was to a great extent corrected by friction over the abdomen for three or four minutes at a time, with cod-liver oil three or four times daily. The manipulation probably did the good, and not the oil, but the use of one of the oils for inunction renders the kneading less painful and ensures its more thorough performance by the nurse. All obstetricians in certain emergencies stimulate the uterine muscular fibres to contraction by kneading the abdomen, and it is probable that the muscular fibres of the intestines are stimulated in a similar manner, so that the intestinal movements are increased by which feculent matter is carried forward.

The external application of cold, so effectual in contracting the uterine muscular fibres, also stimulates the contractile power of the muscular fibres of the intestines. Cold-water bathing, the sudden application of a cloth wrung out of cold water to the abdomen, and in certain obstinate cases even the douche, may be used to stimulate the muscular coat of the intestines and the abdominal muscles to greater activity. Trousseau says: "Before leaving the subject of the treatment of constipation, let me refer to the application of cold to the abdomen—a minor method which I have seen recommended, and have myself prescribed with astonishing success. On rising in the morning let there be placed on the abdomen a compress of several folds soaked in cold water, and let it be separated from the clothes by a sheet of gutta-percha or caoutchouc. This compress ought to remain on for three or four hours." This recommendation by Trousseau is for adults, who are much less susceptible to the influence of cold than children. So prolonged an application of cold and wet to a child, even the most robust, would involve danger, while its application during the brief period occupied in an ordinary bath, with proper exercise afterward or with other measures to prevent chilling, could have no ill-effect.

Therapeutic Measures.—For temporary constipation and many cases that are habitual enemata should be employed, since they promptly unload that part of the intestines in which feculent matter is ordinarily retained, while they do not impair the appetite or produce the prostration which so often results from purgatives. For temporary constipation a warm clyster may be given, and it commonly is more agreeable to the patient than one of lower temperature than the body. Among the enemata which have been found useful are castile soap with molasses and water, salt and water, the various oils, as sweet oil with or without castor oil, linseed oil alone or with molasses, and the gruels, as that of oatmeal or cornmeal made thin. The belief that the frequent use of warm clysters produces a relaxing effect is probably correct, so that if it be necessary to employ clysters often in consequence of the torpid state of the intestines, cool water, the effect of which is tonic and stimulating, should be used. I prefer the use of glycerin and water as a laxative enema. For ordinary constipation in an infant the injection into the rectum of one teaspoonful of glycerin and one teaspoonful of water from a gutta-percha or glass syringe, at a certain hour each day, will rarely fail to give relief.

For infants, a clyster of one or two ounces usually suffices, administered by a gutta-percha or glass syringe, while for older patients a proportionately larger quantity is required, administered by preference through a Davidson, India-rubber, or a fountain syringe. In certain long-continued, aggravated cases the frequent injection of a large quantity of tepid water is indispensable in order to wash away the accumulation of fecal matter. Thus in 1854, Mr. Gay exhibited to the London Pathological Society a boy of seven years who at the age of three years had had typhus fever with dysenteric stools. After convalescence he had habitual obstinate constipation, so that when Mr. Gay began treatment there had been no fecal evacuation for nearly four months, and the girth of the body over the abdomen was forty-nine inches, and yet the appetite and general health were not seriously impaired. The shape of the abdomen and the examination showed great distension of the rectal ampulla and the descending colon. Mr. Gay first distended the sphincter ani, so that it admitted a speculum, and through a rectal tube, well introduced into the colon, the excrement was repeatedly washed away, so that at the time of the exhibition of the boy to the society the measurement in girth gave only twenty-four inches. Evidently in cases like the above no other treatment except repeatedly washing out the intestines with warm water would have answered, and the dilatation of the sphincter ani and the introduction of the speculum to facilitate the escape of fecal matter are noteworthy.

Suppositories may sometimes be usefully employed in place of enemata; cocoanut butter, molasses candy, or soap cut in shape of a pencil may be used for this purpose. In the adult, long-continued constipation is not very rare in which the rectal ampulla becomes so impacted that it is necessary to use the anal curette, the handle of a spoon, or the finger introduced, in order to break up the masses and allow them to pass. In children necessity for such treatment is much more rare, but there are occasional cases, like that above described by Mr. Gay, in which it may be needed. Dr. Nagel states that the evil may be removed by the introduction of a suppository of brown gelatin. This is steeped in water for twelve hours, and, having been thus softened, is introduced into the rectum and an evacuation obtained. The doctor attributes the laxative effect to the hygrometric action of the gelatin. The glycerin suppository of the shops is also very effectual.

The known effect of the galvanic current in producing contraction of the uterine muscular fibres suggests its employment to relieve constipation by stimulating the muscles of the abdomen and the muscular coats of the intestines; and those who have employed it speak favorably of its use. Habershon says: "A galvanic current, transmitted through the abdominal walls, induces a very speedy action, or rather emptying, of the colon. . . . . A case of partial paraplegia, in which injections did not act satisfactorily and drastic purgatives were undesirable, was treated by a galvanic current passed through the abdomen every morning. In a few hours a free evacuation was produced without any discomfort." But the constipation of children very seldom requires the use of galvanism.

The ordinary purgatives should not be given habitually to relieve a constipated habit. They are liable to irritate the intestines, causing a catarrh, or else the intestines become accustomed to their action and a larger dose is needed to effect purgation. Given habitually, they cannot fail also to disturb the digestive and nutritive processes. One or two doses for present relief, both in habitual and temporary constipation, is sometimes required, provided that an injection is for any reason not preferred. For this purpose, castor oil or a few grains of calomel mixed with syrup of rhubarb, the syrup of senna, or the compound liquorice-powder of the German Pharmacopœia may be administered with advantage. But for habitual constipation I strongly advise to discard the ordinary purgative medicines, and if the measures of a dietetic or hygienic character recommended above are not sufficient, to employ such remedial agents as promote, or at least do not impair, nutrition. Probably the best purgative for habitual use is maltine with fluid extract of cascara sagrada.

Belladonna, so highly recommended by Trousseau and others, I have often administered to children, especially in pertussis, in large doses during several consecutive days, but it has not seemed to me to have any decided laxative effect. Though it may be useful in certain mixtures for adults, our experiences in this country with reliable preparations certainly have not been such as to justify its employment as the sole or main remedy for constipation. It diminishes reflex irritability, and may render the action of purgatives less painful, but from its known physiological effects we cannot believe that it increases the intestinal secretions or the action of the muscular fibres, one or the other of which results we expect from the use of an agent which is really laxative. On the other hand, nux vomica and its active principle, strychnia, are doubtless valuable adjuncts to purgative mixtures from their effect in increasing the action of muscular fibres.

Physicians are not infrequently at a loss what to prescribe for the habitual constipation of nursing infants, which is by no means infrequent. But recollecting that colostrum is more laxative than ordinary milk, and that it differs from it in containing more sugar, salts (largely phosphates), and butter, we have a hint, as stated above, as to what is probably lacking in the milk, and what, therefore, should be supplied. I am in the habit of giving the oil, sugar, and salts in the following formula, and usually with the desired laxative effect:

℞. Ol. morrhuæ, 2 parts.
Aq. calcis,
Syr. calcis lactophos., āā. 1 part.

One-quarter, one-third, or one-half teaspoonful may be given with each nursing, or a larger quantity, as a teaspoonful or more, three times daily. Breast-milk with this addition becomes more nearly like colostrum in its laxative properties, while it does not possess those properties of colostrum which disturb the digestive process. I know no agent of a medicinal nature which meets the indication so well as this for infantile constipation. But in my practice I have found it necessary, in not a few instances, to rely mainly on enemata of glycerin and water for the relief of the constipated habit till the infants reached the age when a mixed diet was proper.

The habitual constipation of older children may ordinarily be relieved by the remedies recommended above, but occasionally a more active purgative effect may be needed. Since the portion of intestine which is chiefly implicated in ordinary forms of constipation is the colon, it is evident that if it be necessary to employ frequently any of the active purgatives of the Pharmacopœia, such should be selected as produce little or no irritation of the long tract of the small intestines, while they stimulate the function of the colon. The aloetic preparations are used for this purpose, as the tincture of aloes and myrrh or the simple tincture of aloes, which may be given in dose of part of a teaspoonful in a convenient syrup or in coffee or milk. But I think a preferable remedy is maltine with fluid extract of cascara sagrada, as recommended above, a half teaspoonful of which may be given daily, if necessary, to a child of eight years.

CHAPTER XI.

INTESTINAL WORMS.

THE belief has been prevalent in the profession in former times, and is now among the people, that worms in the intestines constitute a frequent disease, especially in children. As pathology and the means of diagnosticating diseases are better understood, this idea has been gradually abandoned by physicians and the intelligent portion of the community. Still, these parasites must be considered an occasional cause of serious derangements, and in rare instances a cause even of death. They indeed often exist in small numbers without producing any appreciable deviation in the individual from the healthy state; but the most common and best-known species, when they have once effected a lodgment in the intestines of man, ordinarily grow and multiply so as to produce symptoms and require medicines for their expulsion.

So far as is now ascertained by observations in different countries, about fifty animal parasites make their abode in man. It is not improbable that the number will yet be found greater by observations in distant uncivilized countries. Of these fifty, twenty-one reside in the alimentary canal (Heller), several of them being microscopic. Of those occupying the intestines only, the following species are specially interesting to the practising physician on account of their relation—for the most part causative—to certain pathological states: to wit, the ascaris lumbricoides, or round-worm; the oxyuris vermicularis, or thread-worm; the bothriocephalus latus; and three species of tænia, or the tape-worm, and the trichocephalus dispar, or whip-worm.

Ascaris Lumbricoides.—The round-worm has a dingy reddish or yellowish-red color and a cylindrical form, tapering toward both extremities from the point of its greatest diameter, which is a little posterior to the middle. The dead worm is paler than the living. The anterior extremity is tipped with three tips, between which and the body is a circular groove. Between these three tips anteriorly is the aperture of the mouth, from which the œsophagus extends to the distance of one-fourth to one-third of an inch. The intestine, which has a light brownish color, extends from the œsophagus to near the posterior extremity of the animal, where it terminates in the anus. The females are in numerical excess of the males, and their size is also greater. The shape of the worm is like that of the common earth-worm, from which it derives the name lumbricus, but it is somewhat more pointed and its color paler red. The tail of the male worm is curved like a hook, while that of the female is straight.

The total number of eggs contained in a fully-developed female has been estimated at sixty millions. The eggs when immature are conical and are attached to a longitudinal band; when mature they are oval, with dark granular contents and a strong double shell, and their diameter is about $\frac{1}{500}$ of an inch. They are expelled in countless numbers with the feces, and at the time of expulsion are surrounded by an albuminous coating stained with bile. Their vitality is retained under apparently very unfavorable circumstances, even for years. They hatch after they have been repeatedly frozen or desiccated.

The ascaris lumbricoides inhabits the small intestines, where it is rapidly developed from the embryonic state. The remark made by Heller, that when found in the colon it is always dead, cannot be true, for many live worms are expelled in the stools.

The round-worm, more than all other intestinal worms, is inclined to wander away from its usual abiding-place—namely, from the jejunum and ileum—producing symptoms of more or less gravity referable to the part over which it crawls. It occasionally enters the stomach, from which it is vomited, or it ascends the œsophagus into the fauces, from which it is soon removed by the efforts of the individual. Cases are on record—one of which Andral witnessed—in which the worm entered the larynx, producing suffocation and speedy death. M. Tonnellé also witnessed such a case. A child nine years old was suddenly seized with great difficulty of respiration and pain in the upper part of the chest. A careful examination of the thorax gave a negative result. Death occurred in from twelve to fifteen hours, and at the post-mortem examination a lumbricus was found filling the cavity of the larynx. M. Blandin also witnessed a case when interne of the Hôpital des Enfants. An infant was suffocated by one of these worms, which had penetrated as far as the right bronchus. Very rarely they crawl from the fauces into the nasal passages. This worm is so strong and active that there is no recess or reflexion of the mucous membrane of the digestive apparatus which it could possibly penetrate in which it has not been found. It has been discovered in the appendix vermiformis, in the pancreatic duct, in the common bile-duct, and even in the gall-bladder. The number of these worms found in the intestines is very various. There may be only one or the number may be incredibly large. Thus, Barrier relates the case of an infant thirty months old who died in Hôpital Necker. It was believed to be tubercular. Numerous tumors which could be felt in the abdomen were supposed to be tubercular masses. On making the post-mortem examination the mesenteric glands were found healthy, but the intestines throughout their entire extent were filled with lumbrici. The masses which during life were supposed to be tubercular glands were found to consist of worms. The cæcum especially was greatly distended by them. The intertwining or collection in balls of these worms constitutes, indeed, one of the chief dangers, as it renders them so much the more difficult of expulsion.

The round-worm possesses no organs of penetration; still, if the intestine be weakened by disease, especially by ulceration, it may, by pressure with its head, force an opening, through which it escapes into the cavity of the abdomen, causing peritonitis and death. This worm is commonly found, whether single or in masses, surrounded by mucus, which serves as a partial protection to the intestines.

The portion of the mucous membrane in contact with lumbrici is often found inflamed, either from movements of the worm or from pressure of a mass of worms, or even of a single worm in a confined position, as the appendix vermiformis. This inflammation, continuing and increasing, may end in ulceration, and thus a weakened spot be produced which may be ruptured by simple pressure of the mouth of the worm. In this way are to be explained those apparent cases of perforation which have led some observers to believe that lumbrici have actually the power of penetrating the healthy coats of the intestines. The perforation is obviously most liable to occur in those who have been enfeebled and whose tissues have been rendered less firm and resisting by antecedent disease, as by typhoid fever.

M. Guersant describes a case in which the appendix vermiformis contained an ulcerated opening through which two round-worms had partly passed into the abdominal cavity, producing fatal perityphlitis. The effect of their impaction in this narrow cul-de-sac was much like that of a bean or seed lodged in the same situation.

The ascaris lumbricoides has occasionally been found in the most remarkable locations—namely, in abscesses lying without the intestines. They have been known to effect a lodgment in the liver and produce an abscess there, no doubt by crawling up and distending a bile-duct. Their lodgment in other viscera which have no pervious connections with the intestinal tract is probably accomplished through fistulous openings produced by inflammation, which they had no part in causing, as, for example, in the bladder and kidneys, of which there are well-authenticated cases. Worm-cysts in the abdominal walls have been found to occur in most instances in the usual site of hernias—namely, at the umbilicus in children and in the inguinal region in adults. It is presumed, therefore, that the worms had entered hernial protrusions, from which they had passed by ulceration into the abdominal walls and had there become encapsulated.

The *oxyuris vermicularis*, or thread-worm, so called from its resemblance to pieces of ordinary white sewing-thread, is also frequent in childhood and not infrequent in the adult. The length of the male oxyuris is from one-sixth to one-fifth of an inch; that of the female, from one-third to one-half an inch. The posterior extremity of the male is blunt, and is curved or rolled up toward its abdomen; that of the female is slender and pointed like an awl.

The head of this worm is relatively broad, from an unusual thickness or fulness of the cuticle, and the mouth, surrounded by "three nodular lips," is situated in the centre of the extremity. The œsophagus extends backward from the mouth, gradually growing larger like the segment of a long and narrow cone, and ending in a globular enlargement which has been designated the pharynx. From the pharynx the intestine runs in nearly a straight line through the worm.

The eggs are numerous, so completely filling the interior of the female as to conceal the organs from view. They are flattened on one side, but are rounded or convex on other parts of their circumference. One end is more pointed than the other, as in the eggs of birds. Certain of the eggs in the mature female are seen to be undergoing segmentation preparatory to hatching, while others more advanced contain tadpole-shaped embryos, and others still contain worm-shaped embryos either lying within the shells or protruding from them. The hatching and growth of this worm, which have been observed under the microscope, are very rapid under favorable circumstances. "I once," says Heller, "saw the metamorphosis from the tadpole-shaped embryo to the worm-shaped embryo completed in about one hour," but the usual time is longer. Leuckhart saw oxyurides one-fourth of an inch in length fourteen days after the eggs had been swallowed.

Oxyurides may be developed so rapidly from eggs swallowed in the ingesta that they attain nearly or quite their full growth while still in the small intestines, so that, although their chosen residence is in the large intestines, some of them are not infrequently found in the ileum, and even in the jejunum, of full size and active. The part of the intestinal tract which the oxyurides prefer, and in which the largest colony of them reside, is the cæcum and appendix vermiformis, and not in the rectum, as stated in most of the books; and in this situation, where they have been little disturbed, their habits and the relative proportion of the sexes can be best observed. But they are ordinarily found both in the cæcum and rectum in the same individual, and indeed upon all parts of the intervening surface of the colon.

The number of oxyurides in the individual varies greatly. They are occasionally so numerous upon the intestinal surface that they resemble fur, and when they are so abundant they are commonly found above the ileo-cæcal valve as well as below it. The males are smaller and apparently more fragile and perishable than the female. Therefore in the rectum and other exposed situations there is a numerical excess of the females; but in reflexions of the intestines, where they are securely lodged, as in the appendix vermiformis, no marked difference has been observed in the relative number of the two sexes. Since the males are more delicate, transparent, and smaller than the females, they are more likely to be overlooked in a hasty post-mortem examination.

The term *tape-worm* is applied to several species of the tænia and to at least two species of the bothriocephalus, but all except four—to wit, the tænia solium, tænia saginata or medio-canellata, tænia elliptica or cucumerina, and the bothriocephalus latus—are rare in Europe and North America, and are therefore of little interest to the practising physician.

The tape-worm is an hermaphrodite, each segment containing the two sexual organs. The head, or scolex, is small, or about the size of a pin's head, and segment after segment is produced by a budding process from the head. The segments are attached to each other at their extremities, and each segment as it becomes farther and farther removed from the head by the formation of new intervening segments at the upper end of the chain, becomes also larger and more matured. The oldest segments, having attained their full growth, are detached, and have an independent existence. A separation of the chain of segments at any point does not compromise the life of the parasite. If only the head remain uninjured, the segmentation continues from it, and in time the former number of segments and former length of the chain are restored. This worm resides in the small intestines, the larger species sometimes extending from the upper part of the jejunum to near the ileo-cæcal valve.

The *tænia solium* is developed from an embryo known as the cysticercus cellulosæ, contained in the muscles of the hog. It has also been found in some other animals, as the dog, deer, and polar bear. It is a vesicle about the size of a pea or small bean, having a delicate cell-wall, and is nearly spherical, except as its shape is changed by compression between the muscular fibres. At one point of the cell-wall is a depression, attached to the inner surface of which, and lying within the cyst, is a whitish, pear-shaped, solid body, which is the head of the cysticercus, and is identical in appearance and character with the head of the tænia solium turned inside out. Many experiments have shown the close relationship of the cysticercus and tænia solium—that they are two forms of existence of the same parasite. Segments of the tænia solium have been repeatedly fed to pigs, and the cysticercus produced in their muscles, though in what way the ovum or embryo passes from the stomach to the muscles is not known. On the other hand, swine flesh containing cysticerci has been fed to animals who were soon after killed, when the tænia was found in their intestines. It is evident that this parasite occurs only in those who eat swine flesh, as sausages, either raw or but slightly cooked.

The head of this species of tænia, which is about the size of a small pin's head, has at the top a conical protuberance, upon which is a corona of hooklets, arranged in two circles, the hooklets of the outer circle being smaller than those of the inner. The projecting points, however, of the two rows fall together, forming one circle. The hooklets are inserted into depressions in the head, and many of them have fallen out in most specimens which we have had an opportunity of examining. The depressions in which the hooklets are lodged are often dark from pigmentation. Back of the circle of hooks are four sucking discs, which the worm is able to protrude and move freely. When protruded they appear as small tubercles with slender pedicles. The neck, which is slender and about one inch in length, shows markings from commencing segmentation, and it is succeeded by very small and delicate segments, which gradually increase in size as the distance from the head increases.

The mature segments (proglottides) vary in size accordingly as they are in a state of contraction or relaxation. When relaxed their length is about half an inch and breadth one-quarter of an inch. The genital organs are situated on the margin of each segment, a little posterior to the middle, and there is an alternation in their location between the right and left margins in the chain of segments. The uterus lies in the centre of the segment, forming a longitudinal straight line. From seven to twelve branches are given off from each side of the uterus, and these divide and subdivide like the branches of a tree. The male genital organs lie in the same aperture or pore in the margin of the segment, with which the uterus and ovaries connect.

The eggs of the tænia solium are globular, with a diameter of about $\frac{1}{750}$th of an inch, and with thick shells, which are striated like mosaic-work by lines which cross each other. It is estimated that not less than fifty million eggs are contained in all the segments of a matured tænia.

This parasite is very liable to abnormal development. In some instances two or more segments are fused together, and often they are stunted in their growth, or they contain holes, fissures, and flaws, either from their original development or produced by rupture of the distended uterus. Again, rarely, two tænia are blended, so that along the flat side of one chain another is united by the margin, so that a section of the double parasite resembles the Roman letter T or Y. The nutrition of the segments is maintained through a vessel running the whole length of the worm near each margin, and having communicating branches.

The *tænia saginata*, designated also *medio-canellata*, is much larger, stronger, and thicker, both as regards the head and segments, than the tænia solium. When fully matured it measures eighteen feet. The diameter of the head is nearly one line ($\frac{9}{100}$ inch). It is furnished with four strong sucking discs, but it lacks the circlet of hooks which characterizes the tænia solium. Instead of the hooks the head is furnished with a small frontal sucking-disc. The heads of some specimens of this worm are free from pigment, but other specimens present various shades of pigmentation, from a slight staining to a jet black color. The neck is short, and very near the head are markings which indicate commencing segmentation. The matured segments vary in measurement when relaxed—from a length of eight lines and breadth of two lines, to a length of nine lines and breadth of three lines. As in the tænia solium, the genital pores are situated on the margins of the segments, varying irregularly from side to side, and the uterus has lateral branches which divide dichotomously. There is but little difference in the sexual apparatus of the tænia solium and tænia saginata, but the eggs of the latter are somewhat larger than those of the former, and are oval.

The development of the tænia saginata is sometimes irregular, producing monstrosities, as in the tænia solium. The embryos of this parasite occur chiefly in the muscles of ruminating animals, as the ox, sheep, goat, etc., and therefore its presence in man is attributable to the use of the flesh of these animals either slightly cooked or raw. The cysticercus of this species appears to be less tenacious of life than that of the tænia solium, and when it perishes it becomes changed into a greenish-yellow pulp, surrounded by the capsule and imbedded in the muscular or other tissue where it had lodged.

It is easy to distinguish this worm from the tænia solium, if the head be found, by its larger size, the larger size of its sucking-discs, and the absence of the circle of hooks. The segments are distinguished by their greater size and greater number, and the dichotomous division of the branches of the uterus. This species occurs over a much greater area of the earth's surface than the tænia solium.

The *tænia elliptica* or *cucumerina* is a more delicate worm than the preceding species, measuring, when fully grown, from seven to ten or eleven inches in length. Upon its head is a rostellum or beak, which the worm is able to thrust forward, and on which are about sixty hooks irregularly arranged. The anterior portion of the parasite is very delicate, like a thread, and its segments are small, but, as in the other species, they become larger as their distance from the head increases. The matured segments, which have a reddish-white color, are readily detached, and when separated they move about actively. This tænia is also an hermaphrodite, and a genital pore containing a double set of genital organs is located on each margin of the segment. The tænia elliptica inhabits the small intestines of the dog and cat, and many children in different localities have been affected with it.

Heller states that the segments of another and rare species of tænia, which were expelled from a child of nineteen months, are preserved in the Museum of Pathological Anatomy in Boston. Nearly in the middle of the posterior half of each segment is a yellow spot—namely, the receptaculum—full of ova, and therefore the name flavo-punctata has been applied to this worm. Little is known in regard to the tænia nana and tænia Madagascariensis, since they occur in distant countries.

The *bothriocephalus latus* is the largest of the tape-worms, attaining the length of fifteen to twenty-four feet. It is one of the most important of the intestinal parasites. The head has an almond-shape or the shape of an elongated and somewhat flattened globe, its length being about one line and its diameter from one-third to one-half a line. Running longitudinally along each flattened side of the head is a groove or fissure containing the apparatus of suction. Those segments which are still in the process of growth have a breadth three or four times greater than their length, while the matured segments are nearly square. The genital pore occurs in the centre of one side of the segment, and in the chain of segments all the pores are found on the same side. A brownish, rosette-shaped spot is observed at the site of each ripe pore, produced by the convolutions of the uterus and the numerous eggs which this organ contains.

The egg, which is oval, has a thin shell, a light-brown color, and at one end of it is a lid or operculum which is separated from the rest of the egg by a well-defined line. At the hatching an embryo provided with six hooks escapes from the lid. When it has separated from the egg it is provided with an albuminous covering, from which cilia radiate in all directions, by the movement of which it is propelled. After a few days this covering is lost, and the embryo now moves about by amœboid extension and contraction. It is believed that in this embryonic state it enters an aquatic animal, a mollusk or fish, where it undergoes further development, and from the mollusk it is received into the stomach in the food.

The bothriocephalus occurs not only in man, but also in some of the domestic animals which eat fish, as the dog. This parasite is believed to be rare outside of Europe, and in Europe it is chiefly met in countries bordering on inland lakes and seas.

The *trichocephalus dispar* is comparatively unimportant to the physician, since it is uncertain whether it materially impairs the health or produces symptoms. It inhabits the cæcum, but in rare instances it has been found in the ileum and appendix vermiformis. The number of these parasites is usually small, but as many as seventy to one hundred have been observed in the intestine of the adult.

The trichocephalus dispar occurs also in the monkey, and a very similar if not identical worm has been found in the pig. It is not frequent in children, and it has not been observed in very young children. It occurs in man in every part of the globe, and in some countries, as Egypt, Nubia, and Syria, it is said to be very common. This worm, which is also sometimes designated the whip-worm from its shape, attains the length of one and a half to two inches, the female being longer than the male. Its anterior two-thirds are thin, delicate, and flexible, like a small thread. The posterior one-third, which contains the generative organs and intestinal canal, is considerably thicker, and it ends abruptly. On the under surface, extending nearly the whole length of the body, is a longitudinal band, the width of which is about one-third the circumference of the body. In the female the posterior or thick portion of the worm is slightly bent or curved like the stock of a hunting-whip, while that of the male is rolled in the spiral form. The digestive tube consists of an œsophagus which extends through the anterior thread-like part, and the stomach and rectum, which lie in the posterior thick division. The genitals of the female lie in the commencement of the thick portion, and the uterus, when distended with eggs, occupies nearly the whole of this section. In the male, the pore which contains the genitals lies in the posterior extremity of the thick part, where it forms a cloaca with the termination of the intestinal canal. The eggs, which are numerous, are oval, brownish, and with a glistening protuberance at each extremity, giving them the shape of a lemon. They have great vitality, hatching after repeated desiccation and freezing. Their development from the egg is slow. It is believed that the trichocephalus is produced directly from the egg, which has lodged in the intestine, and therefore does not have or require an intermediate stage of preparation in another animal. This parasite resides in the cæcum, but when many are present some are found in the ascending colon, and occasionally a few are observed in the small intestine.

The tænia is rare in early life, but it now and then occurs in young children. I have met cases in this city under the age of five years. Rosen and Bremser report cases between the ages of six and eleven years, and Hufeland one at the age of six months. Wawruch collected 206 observations of tænia, in 22 of which the age was less than fifteen years; the youngest was a girl of three years. A most remarkable case of tænia is reported in the *Gazette médicale* of Paris in 1837. M. Müller was called to treat a foster-child five days old for slight constipation. The bowels were evacuated by the use of rhubarb, manna, and a few grains of salt, and in the excrement a foot and a half of tænia were discovered. This worm had evidently existed during the fœtal life of the infant.

A similar case was treated by Prof. Skene in the Long Island Hospital in September, 1871, and reported by Dr. Armor.[1] The infant was born September 3d of a hearty Irish servant-girl. On the 7th it refused to nurse, and was observed to have a mild form of tetanus. On the 8th, small doses of calomel having been given, followed by castor oil, two segments of a tænia solium were passed from the bowels, and on subsequent days ten more segments, after which the tetanus ceased. The remedies employed after September 8th were the oil of male fern and turpentine. The mother, who had presented no symptoms of tænia, was ordered an emulsion of pumpkin-seeds, which "she faithfully took for twenty-four hours, at the end of which she passed over seventy segments of tænia." This case is interesting as throwing light on a possible mode of the production of tænia quite different from the ordinary and recognized mode, and also as showing the causative relation of intestinal worms to tetanus infantum.

Causes.—It is obvious that intestinal worms are developed from eggs or embryos which are introduced into the stomach in the ingesta. The eggs of the ascaris lumbricoides have been found by Mosler[2] in drinking-water, but it is probable that in most instances they are contained in fruits and vegetables which are eaten raw. The eggs of the oxyuris vermicularis are received from some one who is himself affected with the disease. Both Zender and Heller state that they have frequently discovered ripe eggs of this worm around the nails of persons who were troubled with oxyurides—a fact readily explained from the itching which they cause. If these eggs are upon the fingers of the mother or nurse, it is easy to understand how they are acquired by the child. We can understand also why this worm is so common in degraded and filthy families. In reference to the etiology of the tapeworm nothing need be added to what has been stated above, and little is known in reference to the manner in which the eggs of the trichocephalus are received.

Certain conditions of the intestinal surface favor the occurrence of worms. Thus children in advanced typhoid fever are not unfrequently affected with the ascaris lumbricoides.

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[1] *New York Medical Journal.*

[2] *Virchow's Archiv*, 1860.

SYMPTOMS OF THE ASCARIS LUMBRICOIDES.—These are in part constitutional and in part local, due to the mechanical effect of the entozoa on the coats of the intestines. Writers, especially Rilliet and Barthez, have described with minuteness the symptoms supposed to indicate lumbrici. Those of a constitutional character are the following: Features at one time flushed, at another pallid, and in some children of a leaden hue; lower eyelids swollen, and sometimes surrounded by a blue semicircle; thirst, nausea, or even vomiting; appetite diminished or augmented or variable; breath foul; papillæ of the tongue red and projecting; pulse accelerated and irregular. Rilliet and Barthez state that they observed this irregularity of the heart's action in a boy three years old at the time he was passing a large number of lumbrici. The irregularity afterward disappeared. Acceleration of the pulse and increase in temperature are common symptoms of these worms, and hence the popular belief in a worm fever. This fever is often remittent and mild, but occasionally it is continuous and of a high grade.

The symptoms pertaining to the nervous system are important. In mild cases these may be absent, as when there are few lumbrici and the child is robust and over the age of five years, but in severe cases certain neuropathic symptoms are frequently present, such as dilatation of the pupils, especially inequality of dilatation, to which Munro attached diagnostic value, strabismus, twitching of the muscles, clonic convulsions, somnolence, headache, neuralgic pains, delirium. Rarely chorea, deafness, and paralysis, it is believed, may result.[1] Dr. Leedom[2] of Montgomery county, Pa., relates the case of a boy of seven years who had night-blindness due to a large number of lumbrici in the intestines. By the employment of pinkroot and calomel these were passed and the blindness ceased. Hyperæsthesia of the abdominal surface was present in a case which I attended, and which subsided as soon as the lumbrici were expelled. Grinding the teeth in sleep and picking the nostrils are symptoms to which families attach great value. Observations, however, show that though sometimes due to worms they more frequently have another cause.

The local symptoms or disorders—in other words, those having a mechanical origin—are colicky pains, experienced chiefly in the umbilical region; stools sometimes natural; in other cases diarrhœa with fecal or muco-sanguineous stools; flatulence. M. Davaine at a recent period made the important discovery that the feces of patients affected with worms contain the ova of the particular species present in large numbers. These ova, which have been described above, can be seen through a lens magnifying one hundred and fifty diameters.

In exceptional cases there are local symptoms, due to the presence of these worms in unusual situations, such as a crawling sensation in the œsophagus; a sense of constriction in this tube or the pharynx; nausea and vomiting; a cough, especially if the worm have crawled to the upper part of the œsophagus; rarely the most urgent dyspnœa and probable suffocation if a lumbricus have entered the larynx. Earache and perhaps convulsions if the worm have entered the Eustachian tube (case Davaine, p. 144). The most dangerous symptoms arise from the crawling of the worm into narrow openings.

The enteritis and colitis to which these worms sometimes give rise are ordinarily mild, but in rare instances ulceration occurs, which may be attended by profuse and even fatal hemorrhage. Occasionally very painful and dangerous constipation results from an accumulation of worms in a ball or mass too large to be expelled, unless with much delay and suffering, preventing the passage of fecal matter and producing severe abdominal pains. The symptoms in these cases resemble closely those of intussusception. A marked example of constipation produced in this way occurred in a family with whom I am acquainted and who then resided in the interior of this State. A little girl of three or four years was suddenly affected with obstinate constipation. The physicians prescribed active purgatives, calomel among others, and finally croton oil and various injections, without relief. There was great pain with distension of the abdomen, and death seemed inevitable, when after the lapse of several days a free evacuation occurred, and in the stool was a mass of worms firmly intertwined.

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[1] *Gaz. des Hôpitaux*, 1867.

[2] *Amer. Jour. of Med. Sci.*, for July, 1867.

Children often have lumbrici without any appreciable impairment of the general health, but their presence may intensify the symptoms of intercurrent diseases and greatly increase the danger. Thus I recollect two children of three and three and a half years with pneumonia who at the same time had lumbrici, one passing in the course of a few days thirty and the other twelve of these entozoa. Both presented well-marked physical signs of pneumonia, and, though they recovered, the fever and nervous symptoms were apparently aggravated by the intestinal affection. One had convulsions in the commencement of the inflammation, followed by profound stupor and amaurosis lasting two or three days.

Often the symptoms due to lumbrici coexist with those of a protracted and distinct intestinal disease. Thus, as we have seen, the intestinal secretions of typhoid fever and of chronic diarrhœal maladies afford a nidus for the growth of worms, and accordingly at an advanced stage of these diseases lumbrici are common.

The symptoms produced by the *oxyuris vermicularis* are somewhat different. These worms do not usually cause the fever, disturbed digestion, the colicky pains, or the dangerous nervous symptoms which arise from the presence of lumbrici. Nor do they, like lumbrici, endanger life by crawling into unusual situations. In one recent case I could detect no other cause of chorea than the presence of oxyurides, and eclampsia has been attributed to them, but such a result is exceptional, if indeed the cause be rightly assigned.

Although the cæcum is the chosen abode of this worm, and here more than elsewhere it exists in its normal state, it is not certain that it produces any appreciable symptoms in this part of the intestinal tract.

The symptoms which render this the most annoying of all the intestinal parasites are produced by these oxyurides, chiefly the females, which descend into the rectum, where by their active movements they produce intense itching. A small number of worms cause little inconvenience, but when many are present in the folds of the rectum their crawling produces such intense pruritus that the patient can with difficulty remain quiet. Usually this symptom is most marked in the early evening, when the child is warm in bed. It sometimes causes onanism in the girl as well as boy. This symptom may be nearly or quite absent during the day, but it returns so regularly at night as to resemble and be mistaken for a periodical nervous affection. So eminent a physician as Cruveilhier confesses that he has made this mistake of diagnosis. In the female child the oxyuris occasionally passes from the rectum to the vulva, producing leucorrhœa.

In many instances tape-worms exist in children as well as adults who thrive and present no symptoms, but in other instances there is more or less disturbance of the digestive function, with an uncomfortable sensation in the abdomen. This sensation is more noticed after fasting or after the use of certain kinds of food, and it is diminished by a full meal. Great hunger and a feeling of faintness are also common, according to authorities, but I have not particularly remarked them in children. Irregular action of the bowels, vomiting, and various nervous symptoms, as itching of the nostrils and anus, headache, tinnitus aurium, cardialgia, numbness, deafness, blindness, etc. have with more or less correctness been attributed to the tape-worm. Certainly, such symptoms occasionally arise from this cause, for they cease with the expulsion of the worm.[1] Intermittent colicky pains in the umbilical region were the only marked symptoms in a child with tænia which I recently treated. Since the cysticercus cellulosæ is the embryonic form of the tænia solium, it is quite possible that individuals possessing the latter may be infected from its ova with the former, so that symptoms which have been attributed to the intestinal parasite have sometimes been due to the encysted embryo. We are unacquainted with the symptoms of the trichocephalus, if any occur, and this worm is very rare in children.

DIAGNOSIS.—Bremser long since made the remark—and it has been repeated by most writers on diseases of children—that there is no sign or symptom which affords positive proof of the presence of intestinal worms except the expulsion of one or more. In recent years, however, microscopic investigations have revealed a pathognomonic sign—namely, the presence of ova in the feces, which indicates not only the nature of the disease, but the species of the worm.

The symptoms and disorders produced by lumbrici may all occur from other causes. Still, if several of them be present and a careful examination disclose no other cause, the presence of worms should be suspected, provided that the child be over the age of two years. The microscope may then be used for diagnosis. A little tentative treatment, entirely safe to the child, will also determine whether the suspicion be correct. One or two doses of medicine, administered under such circumstances, like the surgeon's exploring-needle may reveal the nature of the disease and indicate the means of cure.

In the case of the oxyuris vermicularis the itching directs attention to the anus as the place of the disease, and here the offending entozoa may often be discovered by the eye.

PROGNOSIS.—Intestinal worms produce a fatal result in only a small proportion of cases. Oxyurides never prove fatal, unless in rare instances through convulsions. The manner in which death may be produced by lumbrici has already been pointed out.

In general, when the nature of the disease is ascertained the worms are readily expelled by treatment and the patient restored to health. Therefore, if there be no complicating disease the prognosis is good.

TREATMENT.—Much injury has been done to children by the use of anthelmintics occasionally employed by physicians, but oftener by parents before the physician is called. Medicines of this kind are usually irritants, and, in many of those diseases which simulate the verminous affection, but are distinct from it, there is already an irritated if not an inflamed state of the intestinal mucous surface.

Vermifuges administered under such circumstances obviously do harm, and in all acute diseases in which they are not required, even if their action be harmless, their employment is to be regretted, since it consumes time, which is very precious. It is thus that many lives are lost by the use of anthelmintic nostrums which are extensively advertised and which command a ready sale, inasmuch as the belief in the presence of worms as a frequent cause of disease pervades all classes.

A safe rule, followed by many physicians—and it would be much better if it were general—is not to give anthelmintics unless the child have passed one or more worms or their ova be found in the feces, and not then if the symptoms seem to be referable to a coexisting disease. In doubtful cases in which the symptoms resemble those of worms a purgative dose of calomel or calomel and rhubarb may be employed. It will generally bring away one or more lumbrici or a mass of ascaris vermicularis if either species of entozoa be present. This purgative may be safely employed if there be no previous diarrhœa or debility. If after one or two doses and a free purgation no worms be passed, anthelmintic remedies should not be given, for it is almost certain that none exist.

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[1] *Medico-Chir. Rev.*, January, 1868.

A large number of medicines have been employed for the purpose of expelling lumbrici. Santonin, the active principle of the European wormseed, is one of the best, and is much employed in this country and in Europe. It is nearly tasteless; it may be given in powder spread on bread with butter. It is kept in shops in one or two-grain lozenges, with and without calomel. It has the advantage of easy administration, and is destructive to both the round- and thread-worm. M. Bouchut considers it preferable to all other remedies in the treatment of the round-worm. "To children two years of age he administers it in doses of ten centigrammes (1.54 grains), and in patients above this age the quantity is increased by five centigrammes (0.75 grain) for every additional year." He gives in addition occasional doses of calomel or castor oil. In this country santonin is usually administered in one to three-grain doses once or twice each day, with an occasional purgative. The purgative is required to aid not only in the expulsion of the worm, but also of the ova. In over-doses santonin causes vomiting, diarrhœa, and altered vision, so that objects appear yellow, but in medicinal doses it produces no unpleasant consequences. Other medicines are preferable if there be symptoms of enteritis. Treatment by santonin from two to three days suffices. For many years the anthelmintic most employed in this country was the pinkroot, the root of the *Spigelia marilandica*, an indigenous plant. It was not only prescribed by physicians, but employed by families as a domestic remedy. It is liable to cause, if the dose be large, cerebral symptoms, as vertigo, dimness of sight, spasm of the facial muscles, stupor, and even convulsions. These effects less frequently occur if the pinkroot be given with a purgative, and it has been customary to administer it in combination with senna in an infusion. A half ounce of spigelia with an equal quantity of senna is macerated for two hours in a pint of boiling water and then strained. For a child two or three years old the dose is half an ounce to one ounce. So popular has this vermifuge been in this country that probably a majority of the native-born old people in the States recollect the nauseating doses of pinkroot administered by anxious parents. Pharmacy now provides us with the same medicine in a more convenient and acceptable form, that of the fluid extract:

℞. Fluid. ext. spigel., f℥j;
Fluid. ext. sennæ, f℥ss. Misce.

One teaspoonful to a child from three to five years.

The officinal fluid extract of spigelia and senna may be given in the same dose as the above. Professor Proctor recommends the addition of santonin to this extract:

℞. Fluid. ext. spigel. et sennæ, f℥j;
Santonin, gr. viij. Misce.

This is probably the best anthelmintic that can be employed for th destruction of the round-worm in uncomplicated cases, and it is also ver useful in treating the ascaris vermicularis. Chenopodium is also a goo anthelmintic. It is efficient, and at the same time one of the safest in case the mucous membrane be inflamed. If there be abdominal tenderness, with stools too frequent and thin or mucous and tinged with blood, I should prefer the chenopodium to most of the other vermifuges. To a child of three years five drops of the oil may be given three times daily. It may be continued for a longer period than would be safe for most of the other vermifuges. Twice a week, during its use, a mild purgative should be given, as castor oil, rhubarb, or magnesia, unless the bowels are open. It may be given dropped on sugar or in a mucilaginous mixture.

Dr. J. F. Meigs says: "I myself rarely give any other remedy than *wormseed oil* in slight and especially in doubtful cases, unless this has already been tried and failed. From my own experience I believe that this remedy is all-sufficient in a large majority of the cases that occur in this city, as these are almost always of a mild character, and as it not only produces the expulsion of the parasites when they exist, but also acts beneficially upon the forms of digestive irritation which simulate so closely the symptoms produced by worms. I am persuaded, indeed, that of all the cases that have come under my notice in which it seemed probable that worms might be present, none were expelled in nearly half, and yet the signs of disturbed health have passed away under the use of the remedy." . . . . "The following is a very good formula for the administration of this remedy:

"℞. Ol. chenopodii, gtt. lx vel fʒj;
P. g. acaciæ, ℥ij;
Syrup. simplic., ℥j;
Aq. cinnamom., ℥ij. Misce.

Give a dessertspoonful three times a day for three days, and repeat after several days."

In cases of protracted intestinal disease attended by an increased and vitiated secretion from the mucous surface, a state which often gives rise to worms, turpentine is one of the best anthelmintics. In fact, in some of these cases there is no good substitute for it. For example, a boy of about ten years, attended by myself, October, 1864, had reached or nearly reached the fourth week of typhoid fever, when he passed from his bowels a large quantity of blood. He was previously emaciated and weak, and there had been, as is usual in such cases, considerable diarrhœa. The hemorrhage was attended with great prostration, from which, however, he partially rallied by the use of stimulants. On the following day an equally severe hemorrhage occurred, attended with coldness of the face and extremities and great feebleness of pulse, so that death appeared imminent. Turpentine was now administered every six hours, a few lumbrici were passed, and the case thenceforth progressed favorably. The mechanical effect of the lumbrici on the ulcerated surface of intestine had probably given rise to the hemorrhage. Turpentine may be given in doses of from five to ten minims three times daily to a child five years old. Sweetened milk or sugar in powder is a good vehicle for it, or it may be given in a mucilaginous mixture.

℞. Spts. terebinth. rec., ʒij;
Ol. limonis, gtt. v;
Mucil. gum acac.,
Syr. simplic., *āā.* ℥vj;
Aq. anisi, ℥ii–iij. Misce.

Dose: One teaspoonful every six hours.

The following formula for the employment of this agent is recommended by Dr. Condie:

R.	Mucil. gum acac.,	℥ij;	
	Sacch. alb.,	ʒx;	
	Spts. æther. nitr.,	ʒiij;	
	Spts. terebinth. rect.,	℥iij;	
	Magnes. calcinat.,	℈j;	
	Aquæ menthæ,	℥j.	Misce.

It is useless to enumerate the many anthelmintic mixtures which have been extolled from time to time. Those mentioned above are the least nauseous, and rarely disappoint the practitioner. One other antidote for the round-worm should be mentioned, as it has been much used and is efficient—namely, cowhage. This consists of the bristles which cover the pods of the *Mucuna pruriens*, a tropical plant. The pods are dipped in plain syrup of the ordinary consistence, and the bristles are scraped off with the syrup. When enough of the medicine is added to render the syrup of the consistence of thick honey, it is ready for use. The dose is a teaspoonful every morning for three days, after which a cathartic should be administered. I have never prescribed cowhage, although it is not unfrequently ordered by physicians, and a popular nostrum consists chiefly of it.

One affected with tape-worm is obviously cured only when the head of the parasite is expelled; but in the majority of cases which I have observed the head has not been found in the evacuations, even when the treatment had effected a complete cure, as shown by the subsequent history. The chain of expelled segments commonly terminated very near the head. This I believe is the common experience, if we trust the friends of the patient with the examination of the stools. The physician himself should search for the worm's head, the evacuations being preserved. The nurse should be directed to add a little carbolic or salicylic acid, and a sufficient quantity of water to nearly fill the vessel. The liquid should not be roughly stirred with a stick, as physicians are in the habit of doing, since this breaks the worm into small portions and renders the inspection more difficult, but it should be shaken frequently, so as to detach the segments and head, if it be present, from the fecal matter. After it has stood at least five or ten minutes, the worm, which has greater specific gravity than water, sinks to the bottom, and the upper part should be poured off. This process must be repeated till the water is nearly colorless, after which search should be made for the fragments, and the head, if present, will be found.

Since entire expulsion of the tape-worm is effected with difficulty, preparatory treatment for about forty-eight hours should be employed before the vermifuge is administered. During this time the patient should take a mild purgative once or twice, and such food, in moderate quantity, should be allowed as leaves little residuum, as beef tea, milk, etc., with some stimulant if the patient feel exhausted. There are three articles of food which experience has shown to be especially useful in this preparatory treatment, perhaps from a sickening effect which they produce upon the worm—namely, salt herrings, onions, and garlic. They may therefore be taken as food in the twelve or eighteen hours preceding the employment of the vermifuge, which it is ordinarily most convenient to administer in the morning.

The various tænicides recommended in the books are probably all more or less efficient, but the one which has given most satisfaction in the Out-door Department at Bellevue, where probably a larger number of these cases are treated than in any other place in this country, is the oil of male fern; but it is found necessary to employ a larger dose than is recommended in some of the books. For a child of six years the dose employed is one drachm in any convenient vehicle, as the syrupus aurantii florum. This should be followed in about four hours by a dose of castor oil, which completes the treatment. Heller, a high German authority, recommends koosso or its active principle koossin, in the use of which I have had no personal experience. The pumpkin-seed has also been employed at Bellevue and in other parts of this city, but it seems to be less efficient than the oil of the fern. If the chain of segments break near the head and the head be not seen, it will be necessary to wait two or three months in order to determine whether the cure is complete.

The medical journals during the past year have published and extolled the following formula for the treatment of the tape-worm. It is so difficult to expel the head, and tænicides employed singly so often fail in accomplishing this result, that so powerful a combination of tænicides deserves consideration, and perhaps trial. The dose recommended is probably for the adult, but a proportionate dose could be given to a child:

℞. Granati corticis radicis, ℥ss;
Seminarum peponis, ʒj;
Pulveris ergotæ, ʒj;
Aquæ Bullient, ℥viij. Misce.
Fiat infus.

℞. Extracti filicis maris ætheris, fʒj;
Ol. tiglii, ♏ij;
Pulveris acaciæ, ʒij. Misce.
Fiat emulsionem.

Mix the emulsion with the infusion and give them at 10 A. M. A full dose of Rochelle salts should be given the previous evening, and no breakfast taken.

We should hesitate to administer so powerful a remedy to a child under the age of eight years. Perhaps it might be best to recommend one-quarter or one-third of the above dose to a child of eight years, and half the dose to one of twelve or fifteen years.

Since the symptoms produced by the *oxyuris vermicularis* are referable chiefly to the rectum, and are caused by the active movements of the worm, the prompt and thorough use of enemata, which causes their expulsion, is evidently required. Enemata are more effectual if used cool than if warm; and since this worm inhabits the cæcum as well as rectum, large enemata given through a long tube or a large catheter are more effectual, causing the expulsion of a larger number of worms than are expelled by small enemata employed in the usual manner. Various substances have been used for this purpose, as lime-water, table salt in water, turpentine in milk, decoction of aloe, decoction of garlic, etc. Heller says: "Simple water would do well for this purpose, for in a short time it causes the worm to swell up and burst; but it is not altogether without an injurious effect on the intestinal mucous membrane. Hence, Vix recommends a solution of castile soap in distilled water or rain-water of the strength of one to two and a half grains to the ounce. This has no unpleasant action on the intestinal mucous membrane, while at the same time it quickly destroys both the worms and their eggs. . . . . Vix has tested all the medicines usually used in enemata, and has found the above solution of castile soap to be the most effectual." The use of the enema in the evening, although only a small quantity of liquid be employed, so as to wash out the rectum, ensures relief from the itching and sleeplessness during the night.

But it is undeniable that enemata alone do not effect a complete and permanent cure in a large proportion of cases, and hence those affected with this worm remain sufferers for years, having only a temporary respite, unless medicines be administered by the mouth. Those medicines which produce free watery evacuations appear to be the most effectual in dislodging and expelling oxyurides, whose attachment to the intestinal surface is not strong; therefore Heller recommends the saline purgatives "joined with copious draughts of water." The solution of magnesium citrate found in the shops is useful for this purpose.

CHAPTER XII.

INTUSSUSCEPTION.

INTUSSUSCEPTION, or the passage of one portion of intestine into another, has long been known as an occasional accident. Hippocrates, though debarred from the study of morbid anatomy, appears to have had a pretty clear idea of this displacement, and he suggested a mode of treatment which has been employed till the present time.

INTUSSUSCEPTION WITHOUT SYMPTOMS.

This is not properly a disease. It consists in a displacement without any other anatomical change. There is, therefore, no obstruction, inflammation, or even congestion present, and no symptoms. This form of invagination might ordinarily be reduced by the normal peristaltic and vermicular movements of the intestine.

Invagination of a portion of the small intestine into the part immediately below it is often observed at the post-mortem examination of young infants who had presented no symptoms due to the displacement. The invaginated mass is usually from half an inch to two inches in length, and as a rule this accident is multiple. There may be ten or more distinct intussusceptions at distances of a few inches from each other. The simple displacement is believed to occur ordinarily at or a short time prior to the moment of dissolution. It has been supposed to be most frequent in those who have died of cerebral or spasmodic diseases, but its occurrence is not unusual in other pathological states. I have often found it at the post-mortem examination of infants who have had subacute or chronic entero-colitis. Heven states that he has seen it at the Salpêtrière more than three hundred times. Billard has seen it especially in infants who have been subject to constipation. Any irritant, mechanical or other, which disturbs the regular movements of the intestines doubtless may produce it. It has been caused in the rabbit by irritating the anus.

It is not improbable that simple intussusception occasionally occurs temporarily in children whose health remains good when the regular movements of their intestines are disturbed by irritating ingesta or other causes. This form of displacement never takes place in the large intestine. Its usual seat is the lower part of the jejunum and upper part of the ileum. Since it possesses little interest as regards pathology, and none whatever as regards symptomatology and therapeutics, it may be ignored in our description of intussusception.

INTUSSUSCEPTION WITH SYMPTOMS.

Intussusception, or invagination, is one of the most painful and dangerous of human maladies, but fortunately is not very frequent. I have the records of 52 cases occurring in children in addition to the records of several cases more recently observed. From these the facts contained in this chapter are chiefly derived. The patients were under the age of twelve years.

PREVIOUS HEALTH.—In 34 of the 52 cases the state of the health previously to the invagination was recorded. From the following table it is seen that one-half, or 17, were previously well, the remaining half suffering from some disease or derangement:

Age.	Previous Health.	
	Good.	Disease or Derangement.
One year or under	15	8
Over one year	2	9
	17	17

MM. Rilliet and Barthez, whose views in reference to intussusception are derived from the examination of the records of 25 cases, state that the previous health is ordinarily good, and the intussusception is therefore primary. Their remark, according to the above statistics, is seen to be correct as regards patients under the age of one year, but incorrect for those over that age.

Most of the 17 who had previous ill-health had diarrhœa, dysentery, or constipation, or diarrhœa alternating with constipation. Of those otherwise affected, 1 had thread-worms, 2 obscure abdominal pains, 1 nausea and vomiting, and 1, whose age was four months, had had symptoms of invagination when ten weeks old, which soon passed off. It is seen that the pre-existing affections were ordinarily such as would be likely to accelerate the movements of the intestines and at the same time render them irregular.

CAUSES.—The above statistics, therefore, show that intussusception is often preceded by disease or functional derangement of the intestines. The two opposite conditions—namely, constipation and the diarrhœal maladies—so often precede the displacement that they must be regarded as common causes. Another probable cause is intestinal worms, which by their mechanical action stimulate the intestines. They were present in 3 of the 52 patients, though 2 of the 3 seemed well till the occurrence of the intussusception, but the other patient had complained of irritation at the anus, and ascarides had been found on examination.

The use of irritating and indigestible food is an occasional cause. Thus, some who have had intussusception have been in the habit of taking fruits, candies, and pastries freely. Such ingesta may be an immediate cause by their irritating effect, or a remote cause giving rise to diarrhœa, which in turn produces intussusception.

Sex is a predisposing cause, since male patients are largely in excess. Of the 25 cases collated by Rilliet and Barthez, all but 3 were boys. In our own collection the sex of 34 of the patients was recorded, and of these 23 were boys.

In rare instances external violence is the apparent exciting cause. One patient received a severe contusion of the abdomen two years before death, and from this time continued to complain at intervals of pain in the bowels. One writer also mentions the case of a child nine years old, who received a blow from a comrade at school, and from this time had alternately diarrhœa and constipation till the invagination commenced. Rilliet and Barthez also relate the cases of two children who were taken suddenly with invagination when their parents were tossing them in their arms.

AGE.—Of the 52 cases embraced in our statistics, the ages were as follows:

3 were 3 months old.
12 " 4 " "
3 " 5 " "
5 " 6 " "
1 was 7 " "
1 " 8 " "
3 were 9 " "

1 was 10 months old.
1 " 11 " "
1 " 12 " "
2 were from 1 to 2 years old.
8 " " 2 " 5 " "
8 " " 5 " 12 " "
3 not given.

Therefore, no cases occurred under the age of three months; 23 cases were between the ages of three and six months, or nearly one-half of the entire number; 8 between the ages of six months and one year; and only 18 between the ages of one year and twelve. These statistics correspond, in the main, with those of Rilliet and Barthez, in whose collection of 25 cases no one was under the age of four months. Leichtenstern[1] says: "Half of all invaginations, according to my statistics of 473 cases, occur during the first ten years. The first year after the third month is remarkable for a special frequency—one-fourth of all intussusceptions."

The great liability to intussusception in infancy is due partly to the anatomical character of the intestine in this period of life, and partly, doubtless, to the fact that there are more frequent irregularities in the intestinal movements than in older children. In the infant the walls of the intestines are thin, the mucous and muscular coats and the connective tissue being much less developed than in those that are older; the mesentery and meso-colon have also greater depth as compared with the same in other periods of life, except the meso-colon at the points where it passes over the kidneys, in which places it is very short or even in some cases nearly absent. Moreover, the space occupied by the large intestine, in which part of the digestive tube intussusception commonly occurs, is much shorter relatively to the length of the intestine than in those that are older. In about thirty measurements which I have made of the length of the large intestine and the space occupied by it, the latter was found, on the average, about one-third that of the former, which of course necessitates doubling of the intestine on itself. These peculiarities of structure in the infant obviously favor the occurrence of intussusception.

SEAT AND PATHOLOGICAL ANATOMY.—While intussusception occurring without symptoms is usually multiple, that form which occurs with symptoms is ordinarily single. Two exceptional cases which I observed will be presently related. In one of the cases embraced in the statistics an invagination occurred with symptoms, and coexisting with it was another in the small intestines apparently without symptoms and quickly reduced by handling.

While intussusception without symptoms occurs in the small intestine, the seat of intussusception with symptoms is, with occasional exceptions, the colon. The colon constitutes the entire invaginated mass, or else and more frequently it forms the exterior, while the incarcerated portion consists wholly or in part of the ileum.

INTUSSUSCEPTION IN THE SMALL INTESTINES.

Bouchut says: "M. Rilliet states in a recent treatise that in infancy the intestinal invagination is always accomplished at the expense of the large intestine, and that there is never invagination of the small intestine. This is incorrect. I have observed the small intestine invaginated in the adjacent inferior part. Taylor has reported a case of this kind in a child twenty months old who died after an attack of acute peritonitis. M. Marage has seen another case in a child thirteen months old, who recovered after having voided the invaginated portion furnished with two of those diverticula so frequent in the small intestine of the fœtus."

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[1] *Ziemssen's Encyclop.*

But, from all that appears, the case reported by M. Marage may have been, and probably was, an example of the common form of intussusception—to wit, the prolapse of the ileum into the colon. In Mr. Taylor's case the invagination was really of the ileum into the colon, although a small portion of the ileum next to the valve had not been inverted, so that it constituted a little of the exterior of the mass.

Nevertheless, Bouchut is correct in stating that irreducible and fatal intussusception may occur in the small intestines. Probably the displacement is at first of the simple variety, but, continuing and increasing in extent, its return becomes impossible. The positive statement of so great an authority as M. Rilliet, that intussusception with symptoms does not occur in the small intestines, justifies the publication of the following cases, which establish the fact that there are instances, though not frequent, in which the displacement does have this location:

Case 1.—This patient's health had been uniformly good, and nothing unusual was observed in his condition till the age of four and a half months, when he became restless, as if in almost constant pain, with occasional exacerbations. Castor oil was prescribed, which operated freely, and then the following mixture:

℞.	Magnes. calcinat.,	℈j;
	Tinct. opii camphorat.,	ʒij;
	Tinct. asafœt.,	ʒss;
	Aq. anisi,	℥j. Misce.

Dose: Ten to twenty drops, repeated according to the pain.

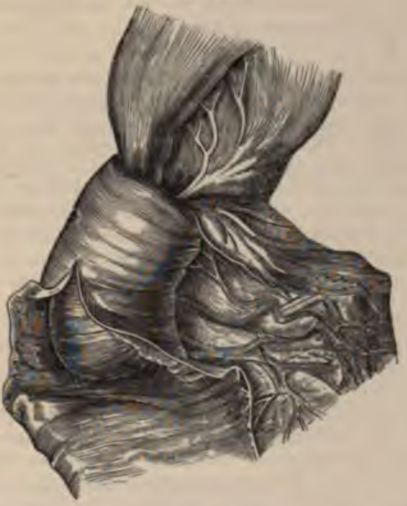
These remedies failed to give relief, as did also chloroform given in doses of two drops. After two or three days another set of symptoms arose, those characteristic of pneumonia—to wit, hurried respiration, accelerated pulse, short suppressed cough, and expiratory moan. He was treated with the oiled-silk jacket and mild counter-irritation, and took an expectorant mixture containing ammonium carbonate. In a few days the pulmonary disease was evidently subsiding, but the pain in the abdomen, with occasional exacerbations, continued. His countenance was pallid and bore an expression of suffering. There was no distension or tenderness of abdomen and no abdominal tumor. He took little nutriment and seldom vomited. In the last part of his sickness the dejections were scanty, and the last three days his stools consisted mainly of mucus and a little blood. The pain seemed to be growing less when he was seized with convulsions, and died the same day, precisely two weeks from the commencement of his sickness.

Sectio Cadaver.—Head not examined; body slightly emaciated; mucous membrane of trachea and bronchial tubes vascular; posterior portion of the lower lobe of each lung solid, of greater specific gravity than water, and allowing only partial inflation; it was in the second stage of pneumonia. Stomach, duodenum, jejunum, healthy. In the upper part of the ileum was an intussusception two-thirds of an inch long, presenting no trace of inflammation either within or around it, and its vascularity, when it was examined externally, did not seem notably increased. Above the intussusception the intestine was empty; below it, and chiefly in the small intestine, was a dark-colored substance, evidently blood, and giving in a few hours the offensive odor of decaying animal matter. There was a passage through the intussusception at least two or three lines in diameter, as shown by a probe. The intussusception sustained the weight of sixteen inches of the intestine, and it would have apparently sustained considerably more. The remaining organs were healthy.

CASE 2.—F. S——, a female infant four months old, was treated at the New York Infant Asylum in June and July, 1865, for entero-colitis, the usual epidemic of the summer season. The following records show the state of the bowels immediately before her death:

June 29th: Has five or six stools daily. 30th: Two stools in twenty-four hours. July 1st: Had two stools since the last record; no vomiting. 3d: Four stools in last twenty-four hours. 4th: The diarrhœa continues, as before; the stools about four daily. On the 6th of July she died.

FIG. 47.



Her pulse during the time in which these records were taken generally numbered about 128 per minute. She was much emaciated, and the day before death she frequently struck her head with her hand. The medicines employed were mainly alkalies and astringents.

Sectio Cadaver.—Parietal bones united; serous effusion over the convolutions of the brain, under the arachnoid; occipital bone depressed; commencing at a point about two feet below the stomach were four intussusceptions two or three inches from each other. The invaginated masses were from one to one and a half inches in length, and three of them were found to be very vascular in their interior. Above, between, and immediately below the intussusceptions the intestine was healthy. One of the invaginations was tested by weight, and was found to sustain a foot and a half of intestine, and would have sustained more. Water poured above these intussusceptions escaped through them very slowly; no fibrinous exudation; descending colon vascular and thickened and solitary glands enlarged.

The irreducible character of the intussusceptions in the above cases was shown by the fact that they sustained weights which doubtless produced greater traction than that exerted by the intestine in its normal action. That the displacement existed prior to the moment of death was shown by the symptoms in one of the cases and by the anatomical changes in both. In one the capillaries of the incarcerated mass were ruptured during the last days of life, so as to produce sanguineous stools, while in the other there was intense congestion of the invaginated mucous membrane, and that portion of this membrane which was adjacent, but not engaged, was healthy.

In both patients the symptoms were less severe than in ordinary cases, and intussusception occurs as above stated in a large proportion of cases. In one case among those which I have collated the invagination began a few inches above the valve, so that the ileum constituted a small portion of the exterior of the mass. Occasionally the cæcum is the part primarily inverted and invaginated, and, descending along the colon, it draws after it the ileum, which sustains its natural relation to the ileo-cæcal valve. When this occurs the cæcum is found at the lower end of the mass, and two orifices are observed, one leading through the valve and the other into the appendix vermiformis. These two forms of invagination—that in which the ileum, passing through the ileo-cæcal valve, successively inverts and draws after it the caput coli and the divisions of the colon, and that in which the caput coli is primarily invaginated, and, descending along the large intestine, inverts the latter and draws after it the ileum—constitute the vast majority of cases of this disease in the first years of life.

I have notes of 45 fatal cases occurring under the age of twelve years in which the portion of intestine first displaced is recorded. In four of these the displacement was entirely in the small intestine, involving in no way the colon; in 38 cases it commenced either by prolapse of the ileum through the ileo-cæcal valve or by the inversion of the cæcum into the ascending colon, there being perhaps not much difference in the relative frequency of these two modes; in one case the invagination was confined to a segment of the transverse colon, in another to a segment of the descending colon, and in the remaining case to the lower part of the descending colon and the upper part of the rectum. In three instances the invaginated mass itself became invaginated, producing an intussusception of great thickness, and necessarily fatal.

Intussusception is sometimes attended by so little constriction of the incarcerated portion that it remains pervious. In such a case life may be protracted for weeks or even months without reduction of the displacement or any material change in it, the passage of fecal matter being sufficiently free for the maintenance of life. Death finally occurs in a state of exhaustion. Thus in one instance a child four months old lived six weeks after the symptoms of invagination commenced, and seventeen days "with a portion of the bowel protruding from the anus." It was found at the post-mortem examination that part of the ileum had descended through the entire colon, and had remained pervious. In a case related by Dr. Worthington[1] symptoms of intussusception were present for seven months before death, and during the last six weeks of life the invaginated intestine protruded frequently from the anus, and was replaced by the mother. In this case "the cæcum was inverted, and, descending through the colon to the lower portion of the rectum, carried with it the ileum and the entire colon except the last ten or twelve inches." In another case the symptoms indicated a continuance of the disease for three, if not eight, months. But such cases are exceptional. Ordinarily, as the intestine becomes invaginated its mesentery or meso-colon is also invaginated and its veins compressed. The pathological state of the incarcerated mass soon becomes that of intense congestion. In infants, usually in a few hours, so great is the distension of the capillaries that they give way, blood escapes into the intestine, and passes from the bowels in scanty motions. On examining the invaginated intestine after death, if gangrene have not occurred, it is found of a uniformly intense red color, sometimes resembling to the naked eye a long and firm clot of blood. In those who die early no traces of inflammation are seen, but in more protracted cases the attrition between the serous surfaces excites local peritonitis. In none of the fifty-two cases which I have collated in which post-mortem examinations

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[1] *Amer. Jour. of Med. Sci.*, for January, 1849.

were made did the inflammation extend more than
invagination. Usually the intestine forming the ex
mass is much drawn together or puckered. In one
the entire large intestine which formed the exterio
pressed within a space of six inches or less, since ab
ileum, doubled on itself, lay within the entire colon
anus, the only part of the large intestine which was
coli. In one case six or seven inches of the ileum, w
the exterior of the mass, were compressed within th

The abdomen, at first of natural fulness and so
and more distended till the close of life; but in cas
distension is moderate. This fulness is due to gas
above the invagination. The portion of the intestin
is ordinarily empty, except that in the infant it co
mixed with more or less blood which has escaped fr
strangulated mass.

There are few anatomical changes in this dis
directly from the intussusception, and are therefore
mass or in its immediate vicinity. In those who r
sloughing the cicatricial contraction may give rise to
greater or less gravity. Thus the late Sir James
child aged nine years who recovered with loss of ten
at the meeting of the Medical Society[1] before whic
sented, he remarked that there was unusual distensio
of the patient, due probably to such compressions of
by the cicatrix that the venous circulation was o
King[2] relates the case of a child aged six years who
the disease voided the cæcum and a part of the
quently pulsation ceased in the left leg, and all tha
became gangrenous. The patient gradually recover
The cause of this unfortunate sequel was doubtles
cicatricial contraction around the artery which suppli
the formation of a thrombus. Dr. F. Bush[3] relates
enabled to observe the extent and appearance of th
aged twelve years, discharged from the bowels fifte
the ileum on the eighth day of the intussusception,
was rapid. Fourteen weeks later the child died from
autopsy "traces of the diseased bowels were visib
puckering where the slough had taken place and
fortunately, in most instances when the intestine
survives, no serious or permanent injury results from
cicatrix stretches little by little and accommodates
parts.

SYMPTOMS.—The symptoms vary according to th
the degree of strangulation. Pain in the abdomen
among the first and is one of the most conspicuous
severe, resembling the pain of hernia, and abatin
strength of the child. After the first few days, if
pain is continuous, though more severe in paroxysms
the abdomen is tolerated, but afterward there is ten
the inflammation which occurs in and around the in
therefore confined to the part of the abdomen in wh
this point also the abdomen is more full than elsewh

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[1] *Trans. Medico-Chir. Soc. Edin.* [2]

[3] *Lond. Med. and Phys. Jour.*, for Decembe

the physician can feel the invaginated mass and detect its exact location and approximately its extent. Sometimes, at an early period as well as late, cerebral symptoms occur, as in a case related by Dr. Coggswell,[1] which terminated in convulsions and death on the second day. Convulsions are, however, comparatively rare, and the mind is generally clear till the last moment. In infants the countenance in the intervals of pain, in the first stages of the complaint, is often placid, and not indicative of any serious disease, but in older patients constant and severe local symptoms, referable to the intussusception, commence early. At an advanced period, whatever the age, the countenance becomes anxious and haggard, the eyes hollow or sunken, the body loses its plumpness, and, if the case be protracted, becomes emaciated.

Vomiting is rarely absent; in 39 out of 47 cases it is stated to have been present, in 7 cases there is no record of this symptom, while it is recorded absent in only 1 case; but in this case, the records of which are very meagre, death occurred on the second day. The vomiting becomes stercoraceous in a few days, and it ordinarily continues with greater or less frequency till the period of collapse. It relieves partially the distension.

The appetite is impaired and often entirely lost. Infants at the breast commonly nurse, however, for several days, probably from thirst rather than hunger.

In most patients one natural evacuation occurs from the bowels after the intussusception commences, and then obstinate constipation succeeds. This evacuation consists of the excrementitious matter below the invagination. In children under the age of one year scanty motions of blood mixed with mucus begin to occur in a few hours. Of 27 children under this age, I find that 24 had such evacuations, occurring in most of them several times in the course of the day; in 2 of the 27 there is no record of this symptom, but in the remaining case it is stated to have been absent. Scanty evacuations of blood unmixed with fecal matter have been considered pathognomonic of intussusception in the infant, and we see the ground for such belief; but in exceptional instances the invaginated mass is partly pervious, and although the dejections may contain blood they are also excrementitious. In our collection of cases are 3 examples of this in infants under the age of one year. One has already been referred to. In this case there was the rare anomaly of so large an opening through the ileo-cæcal valve as to allow not only prolapse and descent of the ileum through the entire colon, so as to protrude six inches from the anus, but also fecal passage through it daily.

In children above the age of one year the capillaries of the invaginated intestines are not so frequently ruptured as under this age, and sanguineous evacuations are therefore less common. I have records of 19 cases between the age of one year and twelve, in only 6 of which it is stated that there were bloody motions, and in these the blood was not passed frequently, nor even in some cases daily, as in infants, nor in so pure a state, unless in 2 cases, the records of which are not explicit on this point. Two of these 6 patients passed moderate bloody evacuations after protracted periods of constipation, one had fecal discharges with the blood through the entire sickness, and in one blood was passed at first, but finally the stools were entirely fecal.

In those above the age of one year obstinate constipation was ordinarily present, no dejections, either bloody or fecal, occurring for several days; but there were a few exceptions. In 3 cases the bowels were relaxed. The ileum in these 3 had descended through the entire colon or the larger part of the colon, and, being pervious, the feces escaped from the anus without detention in the large intestine or with detention only in its lower portion, and were therefore liquid.

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[1] *London Lancet*, for July, 1853.

Tenesmus is another symptom. It is not alway
proportion of cases, even when the invagination is i
large intestine, it is a frequent and distressing sym
commence till there is a considerable amount of dis
when the strength is much reduced.

The temperature of the surface is normal in the
susception; but finally, as febrile reaction symptom
comes on, it rises and continues above the healthy s
sloughs or till the stage of collapse occurs which ush
especially in the infant, is tranquil at first, but, w
becomes accelerated from the paroxysms of pain, an
inflammation which occurs in the invaginated mass.
of respiration, except that it is somewhat hurried
the pain felt in advanced cases on full inspiration.

It will be seen that the symptoms vary in certa
age of one year from those occurring over that ag
symptoms depend more on the degree of invaginatio
on the age and exact location of the disease.

Diagnosis.—The diagnosis of intussusception is
except at its commencement. When the inversion
at which obstruction occurs, the symptoms are, in
disease can be readily diagnosticated. In the cases
lated a correct diagnosis was made with few exception
In the infant the disease for which intussusception
taken is dysentery, on account of the tenesmus an
stools. In certain of the reported cases this mistak
it was ascertained that purgatives produced no fecal

The symptoms which are commonly present,
nature of the disease, are obstinate constipation, vo
referred to the seat of the disease, and tenesmus.
evacuations from the bowels of mucus and blood or
have seen, an important diagnostic sign. It should
ever, that in exceptional cases the displaced bowel
the usual symptoms which possess diagnostic val
There may be no vomiting or tenesmus, and diarrhœa
of constipation, as in the cases related above. A
should be stated that, whatever the age of the chil
ception, clysters are often administered with difficu
forcibly returned, on account of the resistance opp
mass. We have stated above that the seat and even
can be ascertained in a large proportion of cases b
the abdominal walls. The tumor can be felt hard, e
pressure, so that the diagnosis is clear. If the inv
to the lower part of the large intestine, it can usu
examination per rectum.

Duration.—In the following table the duratio
in 49 cases is given as nearly as it can be ascert

2 died the 1st day.	1 died
6 " " 2d "	1 "
14 " " 3d "	1 "
2 " " 4th "	1 lived
5 " " 5th "	tim
2 " " 6th "	1 lived
2 " " 7th "	3, time
1 lived over a week.	7 recov

In 2 of the 3 cases in which the duration is not stated the patient lived much longer than the usual period. One of these 2, a girl of six years, having eaten raw carrots, was seized with pain in the abdomen, which lasted eight months, when she died. During the last three months she passed mucus and blood. In this case the cæcum had descended to the anus, drawing with it the ileum, which remained pervious. The symptoms indicated the continuance of the invagination for three months, if not eight. The other patient was a boy aged three years and four months, who complained of pain in the abdomen for many months, and occasionally vomited. During the last six weeks of his life all the phenomena of invagination were present. In this case also the inverted caput coli had descended the entire length of the colon, and at the autopsy it lay in the rectum.

In West's *Treatise on Diseases of Children* (5th ed., 1866, p. 504) it is stated that death in this complaint always occurs within a week. The above statistics, however, show that there are exceptions to this statement, although a large majority do die within the first seven days. In 33 of the cases embraced in my statistics death occurred within the first week, and in no fatal case in which strangulation was complete was life prolonged beyond the eighth day. In these cases of complete strangulation the average duration was 3.7 days, and the largest number of deaths occurred on the third day. Death on the first day is rare, but it occurred in two of the cases embraced in my statistics. Death at so early a period usually takes place in convulsions and coma.

PROGNOSIS.—Intussusception is in its nature so grave an accident that the physician called to a case should always explain its gravity to the friends. But, while death is the common result, there are three different modes of termination in which life is preserved: First, the reduction of the incarcerated intestine, with immediate relief. There can be no doubt that it is possible for intussusception, when recent, to be reduced by the unaided action of the bowels, in the same way as the common, simple intussusception in the jejunum and ileum or as hernia is reduced, through the vermicular action of the intestines; for sometimes, as in Dr. Coggswell's[1] case, the patients at some previous time have experienced the same symptoms as those which accompanied the attack, and which subsiding they remained for a time in perfect health. This termination is probably rare if the symptoms be sufficiently marked to necessitate treatment. Again, the intussusception may be cured by early and well-applied treatment. The physician often succeeds in reducing the displaced intestine, even if the intussusception be in the upper part of the colon, if he be called sufficiently early and employ the proper measures.

A second mode of favorable termination is alluded to by certain foreign writers. The intussusception continues for a considerable period with the characteristic symptoms, and then, as Bouchut expresses it, "the vomitings gradually cease, the intestinal hemorrhage disappears, the strength returns, and the health becomes restored without the expulsion of fragments of the intestine." What changes the displaced intestine undergoes in these protracted cases, which gradually recover without sloughing, have not been clearly ascertained, although they have been the subject of conjecture. According to Rilliet, a large proportion of favorable cases terminate in this manner. It does not appear, however, from the statistics which I have collected that this is a common mode of recovery. The clinical history of intussusception establishes the fact that in a large majority of protracted cases there is either death or the third mode of favorable termination—namely, by sloughing.

But we cannot reasonably expect recovery in young children through sloughing and the expulsion of the intestine, sin strength for so tedious and exhaustive a process. recovered in this way, so far as I have been able t thirteen months old, whose case was reported b exception of this case the youngest was a boy a the child the greater, of course, the power of end prospect of recovery. Of the 52 cases whose r recovered by the sloughing and expulsion of the m of the ages of five, six, six, nine, eleven, twelve, a aration of the invaginated mass occurred in six o and twelfth days, with an average of nine and a h ing case the time is not given. If, then, the patie the first week without too much exhaustion, discha ing of the bowels, and ultimate recovery may possi

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[1] *London Lancet*, July, 1853.

But in those cases in which the intussuscepti allow the passage of fecal matter, recovery is impr ment be diagnosticated early and properly treate continue, it becomes greater and greater from the Without inflammation and with little or no conge tion, and without the severe symptoms which oc patient wastes away, having irregular evacuations a pain, and finally dies in a state of emaciation an stage of this form of displacement it is not imp inflation, employed with sufficient force, will giv period pass without such treatment cure is im methods. It is in such instances especially—to displacement occurs without strangulation or in fecal matter passes through the displaced mass laparotomy is justifiable, and is likely to give r inflation have been employed in vain. Jonatha performance of this operation in a child of two y displacement is known to most readers.[1]

The prognosis is most favorable when the d lower part of the large intestine, for its reduction i An interesting case of this kind was observed and Reid, and myself in the New York Foundling As was a female aged two years, and had had pre invaginated mass protruded like a prolapse about anus. It was cold, considerable hemorrhage had infant seemed in collapse. When the mass was be carried within the pelvis by the index finger, still be felt like an os uteri. It protruded four o four hours, but by replacement so far as possible w of simple water injections, with the hips elevated, reduced, and, with the use of stimulants, she soon

Mode of Death.—This is different in diffe occurs from collapse. At a meeting of the New held December 10, 1873, I presented a specimen, occurring about one foot above the ileo-cæcal valve months. On the day before its death, its previous it seemed ill, and vomited once or twice, but did no had two evacuations from the bowels, of the usua part of the day. On the following morning it was and died within about twenty-four hours from the c ness. At the post-mortem examination the cranium was not opened, but all the organs of the trunk were found normal except the intussusception. The mass involved in the displacement measured two and a half inches in length and was slightly crescentic. The mucous membrane above and below it had the normal appearance, as had that of the external or incarcerating portion of the mass, while that of the incarcerated part was deeply injected. Water poured into the intestine above the invagination was wholly arrested by it.[1] But in the majority of instances death occurs from asthenia, which comes on gradually, but increases rapidly in consequence of the pain, vomiting, and imperfect nutrition. Children dying in this way may have convulsive movements more or less marked, but the prevailing characteristic as death approaches is extreme exhaustion. In exceptional instances the life of the sufferer is cut short by convulsions before the stage of exhaustion is reached. Thus a child aged three years, whose case was reported by Dr. Isaac Thomas,[2] and another, aged two years, whose case was reported by Dr. Coggswell,[3] died in convulsions on the second day.

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[1] *London Lancet*, November 22, 1

TREATMENT.—It is unfortunate in cases of intussusception that the time in which treatment can be of most service is likely to pass by before the true condition of the intestine is detected. Invagination being comparatively rare, the patient is generally on the first day treated for colic or dysentery or some other common affection of the bowels; and it is often not till the second day, when the intestine has become incarcerated, that the physician accurately diagnosticates the disease. The purgative medicines often given in the commencement injure the patient. In fact, both reason and experience teach us the impropriety of using purgatives in this complaint. Cathartic remedies act as a *vis à tergo*, and may cause still further descent of the inverted intestine. Yet such powerful agents of this class as quicksilver have been employed. It was administered in two doses of one ounce each in one of the cases embraced in my statistics, but none of the mineral passed the bowels. At the post-mortem examination a considerable part of it was found in small globules, coated with a black layer consisting of the sulphuret or black oxide of mercury, in the intestine above the intussusception. It need not be added that the case was speedily fatal.

The proper treatment of intussusception consists in attempts to reduce the displacement by pressure from below. The pressure may be applied either by liquid injections into the rectum or by inflation of the lower intestine by air or gas.

Injections should be made with lukewarm water, for cold or hot water may cause contraction of the muscular fibres of the intestine and increase the constriction. The child should be placed in bed or in the nurse's lap, with the nates elevated 45°. With the common India-rubber—or, better, the fountain-syringe—and the aid of an assistant the liquid should be gently thrown into the rectum until the abdomen is fully distended. By carrying the fingers, firmly but gently applied upon the abdominal walls, along the direction of the colon, the liquid is made to press against the lower end of the intussusception. The same gentleness and perseverance are required in kneading and pressing the abdominal walls as in the treatment of hernia by taxis. If the invagination be in the descending colon, probably only a small quantity of the liquid can be injected, and it may be forcibly returned, but by repeating the injections a sufficient quantity can ordinarily be introduced to obtain the full effect of the mode of treatment. There is also sometimes an increased irritability of the rectum, even when the intussusception is at the upper extremity of the large intestine, so that tenesmus and expulsiv efforts follow the introduction of the instrument. The assistant can aid in overcoming this and in retaining the water by pressing the soft parts of the nates around the instrument.

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[1] *New York Medical Record*, April 1, 1874.
[2] *Amer. Med. Recorder*, 1823.
[3] *London Lancet*, July, 1853.

If the injection fail to reduce the displacement, it may be repeated after allowing the patient to rest for a while. In the *New York Medical Journal* for May, 1875, is the history of an interesting case which was treated by Drs. Church and Warren of this city, and is reported by the latter. The infant was seven months old and had the usual symptoms, such as frequent paroxysmal pain in the abdomen, vomiting, tenesmus, scanty muco-sanguineous stools. On the third day injections were twice employed without result, but on the fourth day an injection of ten or twelve ounces reduced the displacement and the infant recovered. In a second case treated by Dr. Warren the age was nine months, and a tumor appeared a little above the umbilicus a few hours after the commencement of the symptoms. The following is Dr. Warren's account of this interesting case, which will give a clear idea of the proper mode of treatment:

"The patient was looking very pale and prostrated, the pulse was quick and feeble, and the skin cold. I at once determined to use fluid injections, and, with the little patient placed in a semi-prone position in his mother's lap, with an ordinary Davidson's syringe I commenced injecting tepid soap and water, but after perhaps a gill had been thrown into the rectum it was almost immediately rejected, very highly colored with blood, and mixed with it a very small quantity of mucus and fecal matter; the latter, by the way, not hardened, but of the consistency of soft putty. In a second attempt the fluid was retained longer, but was after a little while discharged, with more blood and mucus, but with much less tenesmus and pain.

"When, soon after, I made my third attempt, the child's chest was rested upon the side of its mother's lap, with the lower extremities elevated by an assistant, so that the position was at an angle of about 45°, anus upward. This time I injected the fluid very slowly, in order to avoid, if possible, the irritation caused generally by the frequent emptying and refilling of the syringe (which, by the way, is a very serious hindrance to the successful use of this syringe, and which renders it much inferior to the fountain or hydrostatic). In this manner I succeeded in injecting, as I estimated at the time, perhaps ten or twelve ounces, and during the operation the child gradually became more quiet, and had, when I ceased, fallen asleep. Then, with the direction that occasional doses of tinct. opii camph. should be administered during the night, to control, if possible, the peristaltic action of the intestines, I left him.

"On the following morning, to my surprise, I found the child sleeping quietly and naturally, and I was informed that at about 5 A. M. (six hours after my visit) he had a movement of the bowels, which was saved for my inspection, and consisted simply of the enema, slightly colored with fecal matter. From that time he seemed to be entirely free from pain, and six or seven hours later had a natural passage, after which recovery progressed rapidly, and in a few days he was discharged well."

The following case is interesting as showing success from the use of injections after the lapse of two days in a severe case which had resisted treatment on the first day. The good result was apparently in great part due to the manipulation, which was made so as to press the water against the course which intussusceptions are known to take.

On September 10, 1876, I visited, with Dr. Gillette, a nursing infant aged nine months whose history was as follows: It was habitually constipated, but it continued in its usual health till September 8th, on which day it was carried by its nurse to one of the city parks. After its return it began to be fretful;

it vomited and seemed to be in pain. It continued to vomit frequently, especially after nursing or taking drinks, and in the ensuing night passed two scanty stools of mucus and blood without fecal matter. In the morning of September 9th, Dr. G. was summoned, who found the pulse 180 and temperature 102°, and the matter vomited greenish like bile. In the evening the temperature was 102¾°. Dr. G. diagnosticated intussusception, and employed injections of water, but they were returned without bringing fecal matter and without apparent result. He also administered opiates by the mouth.

September 10th, temperature 102¾°; features pallid, beginning to have a pinched or sunken appearance, and indicative of much suffering; no nutriment is apparently retained, on account of the frequent vomiting, and the bowels are obstinately constipated. As the symptoms indicated rapid sinking and collapse, consultation was called at 4 P. M. It was impossible to determine certainly, through the abdominal walls, on account of the distension, whether there was any tumor, but it was my opinion and the opinion of one of the other physicians that a tumor, hard and inelastic, could be felt nearly in the median line between the umbilicus and the symphysis pubis. At about 5 P. M. the shoulders of the little patient were lowered and the nates elevated, so that the trunk formed an angle of perhaps 45° with the horizontal, and a large quantity of tepid water was gently passed into the intestine through Davidson's syringe, with the vaginal nozzle attached. It was impossible to estimate the quantity retained, since a considerable part of it escaped, although the anus was firmly pressed around the instrument.

When the abdomen was distended as fully as seemed justifiable, the nates being still elevated, and the liquid retained, so far as possible, by firm pressure upon the anus, the abdomen was firmly and deeply kneaded by the hand, the movements being made chiefly from the right lumbar toward the right inguinal, and from the right inguinal toward the hypogastric region. The kneading was continued perhaps eight or ten minutes, and the water, which contained no perceptible amount of fecal matter, blood, or mucus, was allowed to escape.

After this operation the child became quiet, slept, and the vomiting ceased. At our next visit, at 7 P. M., although the severe symptoms had in a great part abated and the countenance had lost that pinched and suffering aspect which was so prominent before, it was deemed best, in consultation, to repeat the injection, and this time through a rectal tube, which was introduced farther than the nozzle employed at the preceding visit. The body was placed in the same position as before and the abdomen kneaded in the same manner. The water, when allowed to return, brought no fecal matter, but the last that flowed contained two shreds, the largest about one inch in length by two lines in width, resembling matted and nucleated epithelial cells. It was believed that they were composed of such cells, with perhaps some of the mucous membrane to which they were attached, and that they were detached from the invaginated portion. An opiate mixture was now prescribed, to be given sufficiently often to relieve any restlessness and keep the patient quiet, and a flaxseed poultice was applied over the abdomen. On the following day the temperature was 103½°, pulse 158, and the abdomen somewhat distended; but the vomiting had ceased and there had been two fecal evacuations since our last visit. The intussusception had been relieved, the inflammatory symptoms soon abated, and the infant's health was fully restored.

Goodhart reports a case of cure by injecting a boracic-acid solution after the symptoms had continued seventy-six hours. The patient's age was eig months, and the tumor could be felt per rectum.[1] Humphreys relates t

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[1] *London Lancet*, Feb. 25, 1888.

cases of recovery by injection of water thirteen a
commencement of symptoms in infants of eight
Butler also succeeded by water injections in red
thirty-six hours' continuance in a child of three y
water have not always been successful. Chaffey fail
of the cæcum and appendix in a "somewhat chroni
bands were found in their vicinity,[2] and Cripps r
injecting water in a girl of eighteen months. The
four or five days, and the tumor projected from

Injections, in order to be effectual and give pron
aided by gravitation. The physician should reme
higher than the shoulders, as in the case related ab
tion—which indeed ought to occur to any intellige
the anatomical condition of the parts as deserving o
brought to the notice of the profession in mode
Mitchell.[4] "I take the liberty," he writes, "of sug
through the medium of your valuable periodical,
bowels by means of a glyster-pipe attached to a co
has fallen to my lot to witness several of these mos
dren; the nature of the obstruction was foretold
nately verified by post-mortem examination. The la
came under my care, about two years since, prese
toms—intolerable restlessness, the most obstinate s
tressed state of countenance, and shrunken featu
were had recourse to—viz. warm baths, glysters, a
abdomen, etc.—but without avail. As a forlorn h
tion by the above means, with the most happy res
diately ceased; the child within an hour passed a
morning was almost without ailment."

This mode of treatment is termed novel in the
old as the time of Hippocrates, who speaks of thro
by which flatulence is imitated (flatus immitatur
mended the same treatment: "Flatus etiam immiss
dispellet." Dr. David Greig[7] relates five cases of
intussusception by inflation. The first, an infant si
in good health, suddenly became very fretful, a
paroxysmal pain in the abdomen. She had vomiti
with bloody evacuations. Warm-water enemata co
account, the writer thinks, of the spasmodic action
abdominal tumor could be felt near the umbilicus.
tive powder and enemata of water having been e
case becoming really critical on the second day, i
The writer says: "The nozzle of a small pair of be
the anus, and air injected to a considerable extent.
tion, the air passed readily into the bowel, and seem
relief. After the injection it lay very quiet, as if a
free from pain. In about twenty minutes from the
administered a slight rumbling noise was heard in
lowed by a crack so loud and distinct as to alarm th
who thought something had burst in the child's bow

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[1] *London Lancet*, Oct. 27, 1888.

[2] *Brooklyn M*

[3] *London Lancet*, July 7, 1888.

[4] *Ibid.*, for M

[5] Hippocrates' *Works*, translated from the Greek by Gr

[6] *Physiologia Corporis Humani*, tom. vii. p. 95.

[7] *Edinburgh Medical Journal*, October, 1864.

continued as if asleep and free from pain, and in about half an hour a large feculent stool, slightly mixed with blood and mucus, was passed without pain. During the night the child rested pretty well, had no return of vomiting, took the breast as usual, and in two days was quite well."

Another child, nine months old, treated by Dr. Greig, presenting nearly the same symptoms and the abdominal tumor, also obtained relief by inflation after castor oil and enemata had failed to produce any benefit.

An apparatus for the production and injection of carbonic-acid gas has been invented by Schultz & Warker of this city, and is manufactured by them. It consists essentially of two glass chambers, one over the other. In the lower one a bicarbonate is placed, and in the upper an acid in a liquid state. By the gradual admixture of the two, carbonic acid is set free. An elastic tube conveys the gas from the lower chamber. This apparatus has been used by physicians of this city for the reduction of intussusception and other purposes, and is a useful invention.

The same firm and several others in this city prepare for the shops large bottles of highly-charged carbonic-acid water, from which, when inverted, a powerful current of the gas can be obtained. Two or three of these bottles, with a portion of the tube from Davidson's syringe, which can be readily attached to the stem from which the gas escapes, constitute all that is required for an ordinary case.

The following cases, which I have treated with Dr. Büchler of this city in 1871, show what may be achieved by inflation, and also the unfavorable result which must inevitably occur in certain cases. A German infant five months old, nursing, began to be fretful, crying often, on March 7th, and before night passed a scanty motion of blood. The symptoms continuing, I was asked to examine the infant on the 10th, and learned the following facts: It had vomited daily, had had daily scanty but infrequent stools, consisting chiefly of blood, accompanied at first by tenesmus, but not within the last day; it continued to nurse, but was becoming thinner and weaker, and was evidently in pain. The symptoms indicating the nature of the disease, the abdomen, which was not distended, was examined for the tumor, which was found in the right side in the site of the ascending colon, apparently about one and a half to two inches in length; pulse 124 in sleep; no cough. An ineffectual attempt was made to reduce the intussusception by a very rude and imperfectly constructed apparatus (the bellows), when from the lateness of the hour further treatment was postponed till early the following morning. 11th. Tumor still detected in the right lumbar region; pulse 120 asleep, 150 awake. By means of Schultz & Warker's apparatus the intestines were inflated so as to produce very decided prominence of the abdomen, and the abdomen gently kneaded. After some minutes the gas was allowed to escape, when the tumor had disappeared. In a few hours a natural evacuation occurred from the bowels, and the infant has remained well since.

The second case ended unfavorably, although the symptoms were apparently no more grave than in the case just related and had continued a shorter time. This infant was also of German parentage. The tumor, firm and elongated, could be distinctly felt in the left lumbar region. In this case the inverted bottles of carbonic-acid water were employed, and when, after considerable delay and kneading of the abdomen, the gas was allowed to escape from the intestine, the tumor had disappeared. A few hours afterward convulsions occurred, ending fatally. At the autopsy the invaginated mass, which was too firmly strangulated to admit of reduction by inflation, w
found in the epigastric region, having been carried up from its former po
tion by the inflation of the intestine below. It consisted of the termi
part of the ileum, which had passed through the ileo-cæcal orifice, and h

become incarcerated in the ascending colon, and, a
cases, the movements of the intestines had changed
in the abdomen from the right to the left side.
Feb. 18, 1888, Cheadle reports a case of successfu
fifteen months, whose symptoms indicated intussu
duration, and the tumor could be felt per rectum.
an intussusception by inflation. The patient, an in
symptoms of intussception three days, and the tu
rectum.[1]

Whether air or carbonic acid be employed, it is
tension of the intestine to its fullest extent below
without endangering rupture, and of course the sc
the chance of success. In a few days the displace
proportion of cases, become so firmly incarcerated,
that attempts to replace it, either by injections or i
still, even at a late period a persevering attempt
not previously been tried. During the four years
the publication of the sixth edition of this treatis
successfully three—I think I may say four—cases o
by frequent rectal injections of warm water as lar
followed by kneading of the abdomen. The youn
Geo. H. Mc ——, male, aged four months, nursing
Dec. 24, 1886. He had been very fretful since D
evacuation on the morning of Dec. 23d, and had si
and blood without the least fecal matter. Enemat
as possible were given every hour to two hours w
were followed by kneading the abdomen. The fr
after these enemata. On Dec. 26th the temperatu
mal, and a fecal evacuation, the first in three days,
the infant was well. The vomiting, which had be
ceased on the 26th. The mother stated that the
a distressing symptom, was uniformly less after th
ence during the last ten years with cases of intuss
and more to the belief that copious and freque
employed in the manner described above, are more
any other mode of treatment. But it is proper th
ing this time I have seen cases that were fatal in w
of treatment, including laparotomy, were employed

If the modes of treatment which I have recom
relief when perseveringly and sufficiently employe
susception, the patient's state is one of extreme
unfavorable. Yet recovery is possible in one of
by incision through the abdominal walls (laparoto
displacement by the fingers within the abdominal
sloughing of the invaginated mass and union by
the ends of the intestine which have preserved the
a remarkable case of spontaneous cure in an infant
been two weeks sick, with vomiting and alvine disch
when presented for examination. A portion of
grenous, protruded from the rectum. This was
sloughy substance were removed daily for a month
recovered. It died of scarlet fever eight month
autopsy revealed the entire loss of the large inte
being united to the anus.[2] Atrophy of the impriso

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[1] *London Lancet*, May 19, 1888.

[2] *Brit.*

in a case which has resisted injections and inflation that it need not be considered in this connection as a mode of recovery.

Laparotomy has been successfully performed in a child aged two years, as I have stated above, by Dr. Jonathan Hutchinson of London. The case was one of those exceptional ones in which great displacement had occurred without strangulation. It had continued, as indicated by the symptoms, about one month, and a portion of the intestine terminating in the ileo-cœcal valve had protruded several inches from the anus. "The patient was anæsthetized by chloroform, and the abdomen was opened in the middle line below the umbilicus. The intussusception was then easily found and as easily reduced. The after-treatment consisted only in the administration of a few mild opiates, and the child made rapid recovery."[1] In a case of this kind there can be no doubt of the propriety and necessity of laparotomy as the last resort, for, there being no strangulation, sloughing could not occur, and death sooner or later from exhaustion must be the result. Cases of this sort have usually been left to perish after the ordinary modes of relief have failed. Thus as far back as 1784, M. Robin published[2] the case of a child aged three and a half years who died after the lapse of three months with a cæcum protruding from the anus; and in the *American Journal of Medical Science* for 1849, Dr. Worthington published a similar case, in which a child aged three years and four months lived a longer time. In these days of anæsthetics, and with the brilliant success of Hutchinson, a physician would, in my opinion, be reprehensible if he allowed a child aged two years or over with this form of displacement to perish without strongly advising laparotomy when injections with water have failed.

But the question arises whether in those more frequent cases of intussusception in young children in which, after displacement has continued a few hours, there is such firm constriction of the invaginated mass that the patient suffers much pain and constitutional disturbance, and passes blood and mucus without fecal matter, laparotomy is justifiable. This operation, in the case of infants, has heretofore been regarded as so dangerous and so likely in itself to prove fatal that the profession have generally considered it unjustifiable, believing that, although death was nearly certain without it, the performance of it did not increase the chances of a favorable result. Dr. J. B. Sands of New York has recently shown that laparotomy is justifiable as a last resort for the relief of this form of intussusception, even in the youngest infants, and in the following case, recorded in the *New York Medical Journal*, June, 1877, saved the patient, who doubtless would otherwise have perished:

On March 11, 1877, an infant of six months suddenly presented the characteristic symptoms of intussusception, such as tenesmus, abdominal pain, vomiting, and bloody stools. A few hours later, when Dr. Sands was called, the pulse was rapid and feeble, with symptoms of collapse. An elongated tumor could be felt in the abdomen, extending from the left iliac region to the left hypochondrium, inelastic, tender on pressure, and dull on percussion. The lower end of the invaginated mass could be readily touched by the finger introduced into the rectum. The usual methods to effect reduction were at once employed with partial success, for the tumor disappeared from the site where it had been discovered, and was reduced to a small and firm mass on a level with the umbilicus, but it resisted any further attempts to effect its reduction.

Dr. Sands then, having etherized the patient, made an incision in the median line of the abdomen, extending downward about two inches from a point a little below the umbilicus. Through this opening, proceeding c
tiously and using as little violence as possible, he was able, after some del

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[1] *London Lancet*, November 22, 1873.

[2] *Mém. de l'Acad. de Chirurg.*

to reduce the displacement. The invaginated mas a half inches in length, consisted of the terminal cæcum, which had entered the ascending colon. five silver sutures, which embraced the peritoneu good recovery. The operation was performed eig mencement of symptoms.

Dr. Sands has collected the statistics of 20 case susception occurring at different ages in which t these, 7 recovered, or 1 in 3; but he judiciously gravity of the operation, that it is doubtful whe show so favorable a result of laparotomy for this the frequent use of the knife. For facts and stat ject the reader is referred to an able and elaborate

It is obvious that the earlier the displacement the probability of the reduction by the judicious tion, and it is seen from cases related above that t cessful as late as the second or third day, after p the intussusception by the same means have faile degree of strangulation that bloody stools occur. rience has shown me, there is also inevitably a la which the use of injections and inflation, howeve ingly made, totally fail, and it seems to me, in t rience, that when pressure from below by water, a efficient mode of treatment short of the knife, has and sufficiently often without result, it is the duty o gical advice in reference to laparotomy, as he woul cially since, under Lister's antiseptic method, the da appears to be considerably diminished. It may performed on the first or second day will be much ordinary cases than if performed later, since th soon badly damaged, and a local peritonitis is likel after the first forty-eight hours.

When an intussusception has reached that st ference by injections, inflation, or laparotomy is no l can only prescribe opiates with sustaining measure over the abdomen, and must await the result. T beef juice and other concentrated nutriment wh Vomiting, which is so common, is best controlled convulsions require the bromide of potassium and grains of chloral hydrate dissolved in a little wate

CHAPTER XI

APPENDICITIS, TYPHLITIS, PERI

The portions of the intestinal tract which are mations are the cæcum and appendix vermiformis, membrane continuous with that of the colon. In and of the appendix so frequently coexist that together.

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[1] *American Journal of the Medical Sciences,*

According to Gerlach, a fold of the mucous membrane after the age of three years ordinarily forms a valve at the upper end of the appendix, so as to prevent fecal matter from entering it. Ransohoff states that this valve prevented rectal injections which he employed, and which reached the cæcum, from entering the appendix. This anatomical fact prevents the more frequent occurrence of appendicitis from the lodgment of foreign substances. The appendix is covered by peritoneum on all sides and in its entire length, and this peritoneum forms underneath it a mesentery designated the mesenteriolum, which attaches it to the posterior wall of the right iliac fossa, and from its length allows considerable mobility of the appendix. If the appendix becomes inflamed and perforated by the lodgment in it of a foreign substance, a localized peritonitis inevitably results. The cæcum anteriorly and laterally is also covered by peritoneum. In rare instances its posterior surface is attached by loose connective tissue to the posterior wall of the iliac fossa, and is therefore without peritoneal covering. Ransohoff states that in 63 post-mortem examinations he found the posterior surface of the cæcum covered by peritoneum in all but 2 cases. Therefore, contrary to the statement of Oppolzer, in posterior inflammation of the cæcum extending through all its layers the peritoneum does not escape. Perityphlitis, as the inflammation is designated when, whether it begins in the cæcum or appendix, it extends to their peritoneal covering and produces the characteristic exudation, is said to be more frequent in males than in females. In Matterstock's collection of cases 51 were males and 21 females, and in Fitz's cases 80 per cent. were males, 20 per cent. females.

No age is exempt from perityphlitis, but, according to all writers whom I have consulted, a large majority of the cases occur under the age of thirty years. Matterstock has the records of 72 cases under the age of fifteen years, tabulated as follows:

	Cases.
Under 2 years	2
From 2 to 5 years, inclusive	10
" 5 " 10 " "	25
" 10 " 15 " "	35

The youngest reported case, so far as I know, was one related by Demme. A female infant, aged seven weeks, had been fed from the age of seven days with porridge. In the third week she was fretful. In the seventh week she was very feverish, was tympanitic, and had tenderness especially marked in the right iliac region. The symptoms indicated peritonitis, and death occurred soon afterward. At the autopsy the lesions of diffuse peritonitis were found, most marked around the cæcum and appendix. The appendix was distended with fecal substance, which, examined under the microscope, was found to consist of hardened masses of the porridge, from which, apparently, the inflammation had originated without producing perforation.

Etiology.—The most common cause of the inflammations which we are considering is the lodgment and impaction in the appendix or cæcum, or both, of fecal matter or hard, indigestible foreign bodies which produce inflammation, and sometimes perforation, by their pressure. In 146 cases of perforation of the appendix collated by Matterstock, fecal concretions were present in 63; foreign bodies different from concretions in 9; neither fecal masses nor hard bodies in 8; and in the remaining cases the records do not mention the presence of any substance likely to cause inflammation. In 49 cases of fatal perityphlitis in children, perforations had occurred in 37. The analysis of 152 cases collated by Fitz gives a very similar result to that obtaine from the examination of Matterstock's records; but Hagen ascertained th

presence of fecal concretions in 69½ per cent., and l
in 30½ per cent., of the cases of perforation of the a
fore regard foreign substances, either concretions
act mechanically by pressure, as the common cau
tion of the appendix, and perityphlitis.

The fecal concretions found in the appendix a
of different degrees of hardness. The hardest mas
centric layers, and contain phosphate of calcium.
tion has a nucleus of some solid substance in the ir
which lodge in the appendix and cause ulceration
in my practice an over-baked bean, hard and blac
and caused an abscess, which by rupturing produce
the substances which have caused perforation an
mention small buttons, beads, grape-seeds, cherry-s
seeds, apple-seeds, and seeds of other fruits.

Perityphlitis may also result from traumatism,
right iliac region, and from tubercular or typhoid ul
exciting cause of the perforation, and of the co
sometimes trivial, and under ordinary circumsta
emetics, purgatives, clysters, vomiting, sneezing,
dancing; but it is supposed that when so trivial a
result an ulcer or abscess was present, and in such
was sufficient to rupture it.

Anatomical Characters.—The initial le
instances in the appendix. Atrophy or necrosi
from pressure of the foreign substance; then the
the exposed subepithelial tissue, causing septic in
mation extends through the muscular coat to th
tissue and peritoneum, causing a local peritonitis,
the peritoneum, producing gangrene or ulceration
and as they contract in healing, the lumen of t
erated and its shape changed. Sometimes the a
obliterated by the inflammatory process, its place
cial tissue, or its proximal end may be obliterated
open. A retention-cyst then results, which may
and may at some point be destroyed by gangrene
retained fecal substance escapes, causing periton
changes occur in the cæcum. Thus Burne relates
years who died after two years' sickness. The wall
gone contraction through bands of connective tiss
irregular and uneven and its capacity much reduce

In the common favorable cases of perityphl
occurs over the inflamed parts, so as to limit the e
prevent the escape of pus or fecal matter. This
the ulcerated appendix is common. The extent an
depend on the size of the perforation and the q
matter that escapes. If the substance which es
be considerable and highly irritating, the perityphli
pus results, forming the perityphlitic abscess. I
abscess is much less frequent in children than in a
upon the place of perforation. It is stated that in
of the abscess is behind or alongside the cæcum, a
walls consist of intestine and the posterior and la
men. If the appendix be long and extend to the
and the perforation be near its distal end, a some

abscess may press upon the rectum or uterus. The presence of fecal matter with its microbes in the pus renders it very irritating and poisonous.

The abscess, left to itself, may open in any direction. It sometimes discharges into the intestine, either into the lower end of the ileum, the cæcum, ascending colon, or rectum, through an opening that is quite small in the mucous membrane, but larger in the other intestinal coats. Evacuation of the pus per rectum, sometimes tinged with blood, has been regarded as favorable from the time of Dupuytren. It occurred in 18 per cent. of the cases collated by Fitz, the pus breaking into the intestine at some point above, and escaping by the rectum. But the result is not always favorable when the abscess breaks into the intestine, for after the pus has been evacuated fecal matter may escape from the intestine through the opening, carrying with it microbes which may poison the system and set up septic fever. Of 6 cases related by Demme in which the abscess broke into the intestine, 3 subsequently died. Henoch states that abdominal abscesses are very prone to escape at the umbilicus, since this is the weakest part of the abdominal wall. Rarely the pus makes a passage into the bladder, and if this occur, cystitis, due to the presence of purulent and fecal matter, may result. The inflammation has also, in a case mentioned by Eisenschütz, extended from the perforated appendix to the right ovary, producing purulent inflammation in this organ. Extension of the inflammation from the perforated appendix to and around the contiguous blood-vessels may produce disastrous results. The superior mesenteric vein, which conveys blood from the cæcum and appendix to the portal vein, sometimes becomes the seat of thrombosis, the circulation in its branches being interrupted by the presence and pressure of inflammatory products. Detached particles of the thrombi, conveyed through the portal vein to the liver, produce septic inflammation and abscesses in this organ. Matterstock has the records of eleven cases in which the liver became involved in this manner. Occasionally the abscess ascends along the colon and behind the liver, becoming subdiaphragmatic, and cases have been reported in which it entered the right pleural cavity. Tillmann states that in 22 cases of fecal fistula extending into the pleural cavity, 6 originated from perforations in the appendix. The abscess penetrating the retro-peritoneal tissue may extend to the kidney, so as to become perinephritic, or it may descend along the psoas and iliac muscles, even under or below Poupart's ligament. Cases are reported in which it burrowed under the gluteus maximus muscle or in the perirectal tissue, occupying the sacral or coccygeal region.

Evidently, inasmuch as the appendix is invested by peritoneum, its perforation and the escape of fecal substance or a foreign body, which produces the abscess described above, cannot occur without a localized peritonitis behind and below the cæcum, where the appendix lies. But a more serious and ordinarily fatal result sometimes follows—to wit, the occurrence of acute diffuse peritonitis. This may take place immediately after the perforation, but frequently an abscess forms, perhaps of little extent, around the appendix, and it may continue for weeks or months without producing any dangerous symptoms. Finally it bursts, and its contents escape into the general peritoneal cavity, producing an acute peritonitis, which rapidly extends over the peritoneal surface. A large proportion of the cases of perforation of the appendix if left to themselves terminate, after a time, in this manner, in peritonitis, which from its extent and severity is usually fatal. This was the result, according to Volz, in 31 of 39 cases, and, according to Cless, in 7 out of 8 cases.

SYMPTOMS.—The initial symptom of the inflammation, typhlitis, appendicitis, and perityphlitis is pain, more or less severe, in the region of the appendix or cæcum, perhaps at first paroxysmal, with intervals of comparative

ease, and accompanied by tenderness. The patien
even vomiting, constipation or diarrhœa, flatule
experienced physicians sometimes diagnosticate in
serious malady which is impending. These sym
frequently abate for a day or two, and the patien
they return with equal or greater severity.

When the disease is fully established the seve
is constant, and the patient takes to bed, unable t
He inclines forward and to the right, and his rig
the tension. Sometimes he refers the pain to th
men, and it is increased by coughing, by full in
of the right thigh. The patient is quiet in bed
ness. Distension of the stomach with food or
Vomiting of the ingesta mixed with mucus and l
tions of gas may occur. Occasionally these sy
chill, but less frequently in children than in adul
symptoms commonly present: anorexia, thirst, fev
(101° to 103° F.), accelerated pulse, features in
sometimes icteric hue of skin and conjunctiva, p
nation or retention of urine, diarrhœa or constipatio
tense at first, but subsequently abdomen tympani
at first in the right iliac region, but subsequently
of the ileo-cæcal region, at first from gas, subs
cæcal tumor, tender and immovable; adjacent lo
Such are the symptoms and phenomena that att
on the crural plexus may cause numbness, pain, o
in the right leg and the external genital organ
vein may retard the return circulation from the
the limb.

The progress of this disease and its gravit
cases. In the mildest forms of the inflammation t
cæcal tenderness, and fulness gradually abate, and
health is restored; or the symptoms may contin
after the discharge per rectum of gas and offen
induration and soreness, gradually abating, may
disease for months, and the patient may complain
full meal or active exercise. When the abscess c
dangerous symptoms abate rapidly, and the patien
to convalesce.

In other cases the symptoms continue, but w
the fact that the abscess, which does not dischar
condensed connective tissue which limits its exte
some unusual effort or a blow or pressure upon t
vation of symptoms occurs. Purulent or septic m
at some point, and peritonitis may have resulted, c
been described above, or septic inflammation in s
sudden advent of alarming symptoms when the
tively comfortable, severe and general abdomin
pulse (150 to 160), a high temperature (105° or
for the other symptoms, painful respiration, tense
cles, followed by tympanites and distension, indic
general peritonitis, and rapidly approaching deat
diate laparotomy be performed and the peritone
warm antiseptic lotion. In this alarming state,
tions, constipation, more rarely diarrhœa, retentio

rations, hiccough, flexed thighs, pallor, and finally collapse, indicate the fatal progress of the attack.

To add to the gravity of the situation, septic inflammations in other parts sometimes start up, as empyema or pericarditis, cystitis, perhaps with perforation of the bladder, inflammation around or within the female genital organs or in the retro-peritoneal connective tissue.

On the other hand, it must be remembered that in a considerable proportion of cases the abscess is so encapsulated that septic poisoning and diffuse peritonitis are prevented, and after a time it begins to point at some place where it has approached the surface, and the pus escapes spontaneously or is released by the knife, and the patient immediately begins to recover. Prof. Henoch has witnessed the discharge of pus through the umbilicus, and he believes that this is quite liable to occur, from the fact that the abdominal wall is thin and yielding in the umbilical region.

Of the symptoms enumerated above, pain is one of the most constant, and was present in 84 per cent. of the cases collated by Fitz. It is of course less severe if the inflammation is localized in the ileo-cæcal region, and of little extent, than when it occupies a wider area. Fitz, in his examination of the records of patients, ascertained that the pain was referred to the ileo-cæcal region in 48 per cent. of the cases of appendicitis and in 60 per cent. of perityphlitis, to the abdomen in 36 per cent. of the cases of appendicitis and in 34 per cent. of the cases of perityphlitis. In a few instances the pain was referred to the hypogastric, umbilical, or epigastric regions, and in rare instances to the region of the liver, left iliac fossa, and the right hip and groin. Cessation of pain when the other symptoms are severe indicates commencing collapse.

Vomiting is one of the most common symptoms. It was absent in only 2 of the 72 cases collated by Matterstock, and was present in Pepper's 13 cases. It appears to be more common in children than in adults. Diarrhœa was present in 33.3 per cent. of Matterstock's cases, and constipation in 46.6 per cent., alternating constipation and diarrhœa in 15.5 per cent., and normal stools in 4.5 per cent. of the cases. According to Pott, diarrhœa is more common than constipation in children,[1] and in fatal cases approaching termination severe colliquative diarrhœa sometimes occurs.

More or less fulness and induration can usually be detected in the ileo-cæcal region at an early as well as late stage of the disease, but a distinct tumor is only occasionally perceptible. According to Pepper, in 19 children with this disease a tumor could be detected in only 3 instances. A dull percussion sound in the right ileo-cæcal region is common, but occasionally, even when there is considerable inflammatory induration, loops of intestine distended with gas lie over the seat of inflammation, so that the percussion sound is resonant. The temperature usually ranges from 100° to 103° or 104°. It is sometimes remittent. In a case treated by the late Dr. H. B. Sands the temperature fell from 101.6° before laparotomy to 98.5° immediately after the operation, and it remained below 100° during convalescence. A sudden rise in temperature indicates extension of inflammation or perhaps the occurrence of septic inflammation in organs not previously involved. A sudden fall of temperature when other symptoms are grave, like cessation of pain, indicates collapse.

Diagnosis.—Recurring pain or tenderness in the cæcal region at intervals of a few weeks should excite suspicion of the presence of a foreign substance in the appendix. Dr. C. E. With[2] found that such recurring attacks preceded the severe disease for weeks, months, or even years in certain cases,

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[1] *Jahrbuch für Kinderheil.*, N. F. xiv.

[2] *Peritonitis Appendicularis, etc.*, Kjöbenhavn, 1879.

and in the large number of cases which he collat
that these occasional attacks of pain and tenderne
per cent. of the children affected. Sometimes the
ter in the cæcum can be determined by palpation, si
feel. The diagnosis of this inflammation from inva
the latter occurs chiefly in infancy, is attended by a
in the abdomen than the ileo-cæcal induration wh
is attended often by bloody stools and fecal vo
states that four children with perityphlitis had be
dic hospital in the belief that they had hip diseas
it; but a more careful examination of such ca
shows that the hip-joint is not affected. The sw
lower down than the perityphlitic induration. B
produce the change in the appearance of the
behind, or in the position of the foot, which we
Senn[2] recommends rectal injection of hydrogen
ing the presence of perforation of the cæcum or ap
foration the gas enters the peritoneal cavity, and
indicated. The diagnosis from a psoas abscess m
the following facts: This abscess occurs graduall
able to the intestines or peritoneum, and without
perityphlitis. Moreover, the abscess usually des
cle and forms a swelling under Poupart's ligame
thigh under the fascia.

PROGNOSIS.—This varies greatly in different
be of little extent and encapsulated, and sepsis d
good. On the other hand, if the perforation of
of considerable size, with considerable escape of
is with microbes, the severe inflammation which
retro-peritoneal tissue, with perhaps consecutive
cent organs or tissues, to which septic matter has
phatics or blood-vessels, a fatal termination is al
that the statistics relating to the result, as asce
vary according to the average severity of the ca
sult. The following statistics have been publis
termination of appendicitis, typhlitis, and perit
disease:

Authors.	Deaths.
Volz	39
Bamberger	18
W. T. Bull	33
Matterstock	49
With	12
Demme	27

According to Matterstock, age influences the
12 patients under the age of six years, 11 died;
ages of six and ten years, 15 died; and of 34 p
ten and fifteen years, 23 died. A diffuse peritoni
diately from the perforation or from rupture of
previously encapsulated and indolent, is usually
abscess into the cæcum or rectum justifies a f
some die in which this occurs. Evacuation of
walls, if it take place at an early date, is also re
rotomy, which consists in evacuation of the pus t

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[1] *Amer. Jour. of Med. Sci.*, 1881.

[2] *Jour. of the Ame*

if performed at the proper time and with antiseptic precautions, increases the chances of recovery. According to Noyes,[1] in 100 such operations the mortality was only 15. But according to Bull, the result is not so favorable if the abscesses burrow their way to the surface and open without surgical assistance, for of 28 such abscesses, 11 were fatal.

How long patients may live in fatal cases after the occurrence of severe symptoms has been investigated by Fitz, who found that in 176 cases 34 per cent. died in the first five days, more than half in the first week, 31 per cent. in the second week, and 4 per cent. in the third week. In those mild cases in which the inflammation in the cæcal region is of slight extent and the patient is soon convalescent, a sudden aggravation of symptoms sometimes occurs from breaking loose of the inflammatory products or septic absorption, and the case ends fatally.

TREATMENT—*Prophylactic.*—Children should have plain and easily-digested diet, from which seeds or other indigestible substances are removed so far as possible. They should be instructed to reject the seeds of the ordinary fruits which they are allowed to eat, since seeds are the offending substances which cause appendicitis and perforation in so large a proportion of cases. Daily fecal evacuations should be procured, so as to prevent fecal accumulation in the cæcum. If there be complaint of colicky pain in the abdomen while the bowels move regularly, or if there be occasional pain or aching in the cæcal region, a careful examination should be made in order to ascertain if there be tenderness or induration at the point complained of, and if so a quiet life with open bowels should be enjoined. By such measures the threatening symptoms may pass off.

Curative.—Prof. Henoch of the University of Berlin, whose opinions relating to the diseases of children always claim attention, if not acceptance, on account of his large experience, says that whether the inflammation occurs from over-distension of the cæcum by fecal masses or from concretions in the appendix, the symptoms are the same as in later life—to wit, pain in the cæcal region, which is likely to extend over "a large part of the peritoneum; the frequent formation of a tumor by the exudation, which not infrequently terminates in suppuration; the repeated relapses, etc." Henoch states that he keeps the intestines perfectly quiet by opium, and only gives castor oil or calomel when prolonged constipation and palpation indicate the presence of a large fecal accumulation in the cæcum; otherwise, he abstains from purgatives, applies a few leeches, without after-bleeding if there be much tenderness, gives an emulsion of oil (emulsio oleosa), with the aqueous extract of opium every two hours, and uses constantly the ice-bag over the cæcum. When with this treatment the pain and tenderness cease, he states that defecation usually occurs spontaneously or is produced by a simple enema or a dose of oil. The following remark might be thought to be an exaggeration were it not for the well-known accuracy and high professional standing of Prof. Henoch: "When this treatment was begun early enough recovery ensued in almost all cases, and if a swelling had been formed by the exudation, its transition into suppuration was prevented even in children who in the course of a few years had been repeatedly admitted to the hospital on account of relapses." The treatment detailed above, employed and recommended by Prof. Henoch, is in my opinion the best that can be prescribed for typhlitis, appendicitis, and perityphlitis before suppuration has occurred. The use of laxatives, even of laxative enemata, should be postponed until the tenderness and other inflammatory symptoms have to a considerable extent abated by the use of the ice-bag, and opium in sufficient doses to allay

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[1] *Trans. Rhode Island Med. Soc.*, 1882.

restlessness and procure sleep. If, when the infla
we ascertain by palpation the presence of fecal m
clyster of warm water, containing one ounce of
oil, may be prescribed, or perhaps, as recommen
orem of castor oil or calomel may be given. Eve
the treatment, if there be the history of constip
cæcum appears to be distended with fecal matte
large clyster of warm water, containing one ou
sweet oil, in order to remove a chief cause of i
consist of liquids that leave little residuum, as
tonized milk. Carbonized water may be allow
nausea. If the case result favorably, the child
avoiding violent exercise during and after conv
infrequent.

If the inflammation continue and suppura
abscess forms, which requires incision if the diag
America the advantages of early liberation of th
was brought to the notice of the profession by th
whose first case of successful operation occurre
the treatment of perityphlitic abscesses by inci
numerous instances, so that Dr. R. F. Noyes in 1
records of 119 cases, only about 16 per cent. of

Dr. Sands strongly objected to the use of the
stage of the inflammation, employed for the p
presence or absence of pus, since it might pene
cavity and pierce the intestine or pus-cavity, and
substance adherent to it would probably infect
diffuse peritonitis. G. Buck, Wier, Noyes, and
of pus be determined by the needle, to leave it *in*
guide in making the incision. Morton states that
never be used, and Ransohoff also objects to it.
incision and entering the peritoneal cavity, finding
by omentum, closed the opening and made the cu
the peritoneum was adherent to the tumor, and th

Sands recommends making a vertical incision
ing the readiest approach to the diseased parts
and others make the incision, four inches in leng
parallel with the outer half of Poupart's ligame
make a curved incision along the crest of the il
and Parker, make the incision at the most promi
nearer the median line than most other operat

Laparotomy, or the opening of the abdomina
evacuating the perityphlitic abscess, has been pe
ber of times during the last ten years, and cases
ing very favorable results. But it must be bor
cases are much more likely to be reported than
reported the following case in 1882: A boy, sick
130, temperature 101.6°, respiration 32. A
revealed the parietal peritoneum thickened and
needle introduced drew pus. A free incision was
and one ounce of fetid pus escaped. The cæc
intestines were covered with pus. The perit
adhesions, was diffuse. Three fecal concretions
in the appendix. The abdominal cavity was i

[illegible] *of Rhode Island Med. Soc.*, 1882. N then by half a pint of corrosive-sublimate solution, 1 part to 1000. The wound was partially closed by interrupted silk sutures, the part not closed being packed by iodoform gauze extending to the loops of small intestine. The drainage-tube was not used. The patient immediately began to improve and recovered.[1] Homans relates the case of a boy of eleven years who had had pain in the ileo-cæcal region five days, and had been in bed three days. He had dulness and tenderness on percussion in the right iliac region, without swelling; pulse 120, temperature 102.4°. The incision, made half an inch anterior to the crest of the ileum, revealed healthy loops of intestine, but below and behind them were deeper loops agglutinated by the inflammation. On separating the adhesions a cavity was reached, from which two ounces of fetid pus escaped, which, so far as possible, was removed without flowing over the healthy peritoneal surface. Double rubber tubes were introduced and the wound was closed around them. This case occurred before antiseptic measures were so generally employed as at the present time, but the patient progressively improved, and was out of bed after three weeks, the discharge from the tubes being abundant during two weeks.

Such cases show what may be accomplished by surgical treatment of the perforated appendix and perityphlitic abscess, even in cases in which diffuse peritonitis has resulted; but of course when peritonitis not limited by adhesions occurs, death will inevitably result in a considerable proportion of cases under any treatment.

Removal of the perforated and diseased appendix, when it can be readily brought into view, has been recommended and performed by Sands, Morton, Hoffmann, and others, and it is generally advised by the writers of the various monographs on this disease, since it is a source of irritation, and by the subsequent escape of fecal matter might cause a renewal of the inflammation. But in a large proportion of cases the appendix lies at the bottom of the cavity surrounded by adhesions, so that it cannot be removed without considerable cutting and tearing of the parts which surround it, and perhaps producing an opening through which inflammatory products may escape into the peritoneal cavity. Attempts to remove it under such circumstances would not be justifiable. If it be accessible, the cautious and experienced surgeon will understand in what way its removal can be best accomplished.

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[1] *N. Y. Med. Jour.*, Feb. 25, 1888.

SECTION I

DISEASES OF THE GENITO-URI

Uric-Acid Infarctio

Infarctions of uric acid or the urates are infants. They are seen, if an opportunity of ex as yellowish-red lines in the tubules or lying i forming small yellowish granules. As they are we often find them upon the diaper. The irritati tions sometimes causes painful micturition. Chil fret or cry from pain during urination in consequ of the uric acid, while in the intervals between may or may not be free from suffering. Perhaps of urine with straining, and in it we find crystal Urine highly acid from the presence of this subs in the urethra, and sometimes redness not only the labia over which the urine flows. Although from this cause, the same condition not infrequen Their urine, previously normal, becomes unduly a ing or in the digestive process, and uric-acid c An exaggerated secretion of mucus occurs from or from the urinary canal in consequence of the acid, and sometimes pus-cells are also seen under the mucus.

The state of the urine described above shoul furnishes the conditions in which calculi form eit ney or in the bladder. Urine unduly acid and causes catarrh of the delicate membrane lining t kidneys, and if the irritation be sufficiently sever the ureters to the bladder, causing a degree of c the pelvis of the kidney or the bladder greatly in formation of calculi, since the crystals become im serves to agglutinate them. Uric acid, when so cause symptoms, should be at once treated and alkali. The liquor potassæ, employed as recom the treatment of Enuresis, is the best alkali for t of one year, two drops sufficiently diluted in repeated in three or four hours.

Enuresis.

Enuresis, or incontinence of urine, is a commo in children. It occurs both in boys and girls, b former than in the latter. In many children it dates back to infancy, but others have a respite from it in the years immediately succeeding infancy until the sixth or seventh year, when it returns. It may be diurnal as well as nocturnal, interfering seriously with the comfort of the child and rendering his schooling inconvenient; but the annoyance which it causes is commonly most at night, and it is for nocturnal enuresis that the physician is most frequently consulted. The child may pass his urine in bed every night, or even more than once each night, or there may be occasional nights of immunity.

The bladder consists of three concentric coats: 1. On the outside the peritoneal, which covers the posterior, the superior part of the lateral, and the anterior aspects of the organ; 2. The muscular, which chiefly concerns us at present, and which consists of two layers—the one external, the fibres of which have a general longitudinal direction; the other internal, whose fibres are circular. The circular fibres become more abundant, producing greater thickness of this layer, at the urethral orifice, and they extend a distance over the urethra. This increase in the number of circular muscular fibres at the urethral orifice constitutes the sphincter vesicæ. The fibres in the muscular coat of the bladder are unstriped, and are not under the control of the will.

A second sphincter, which aids materially in the retention of urine, is formed by the compressor urethræ. This muscle, arising by aponeurotic fibres from the ramus of the pubes, surrounds the whole membranous portion of the urethra, extending from the prostate to the bulbous portion. The compressor urethræ is a striped muscle, and its action is therefore controlled by the will. Certain accessory muscles influence the retention as well as the expulsion of urine—to wit, the levator ani, acceleratores urinæ, and the abdominal muscles.

Nerves.—The muscular coat of the bladder receives its nerves from the hypogastric plexus, which belongs to the sympathetic system, although filaments enter the plexus from the spinal system. The innervation of the bladder is therefore twofold, that derived from the sympathetic system predominating over that from the spinal system, as shown by the relative number of filaments from the two sources. According to Belfield, the spinal centre of the motor nerves of the bladder is in the vicinity of the third lumbar vertebra; but Budge, in his experiments on rabbits, locates it in this animal in the vicinity of the fourth lumbar vertebra. The spinal centre of the nervous supply of the bladder, says Coulton, "is connected with the brain by a strand of fibres which may be traced from the cerebral peduncle along the anterior columns of the spinal cord." The neck of the bladder, including the sphincter vesicæ, derives nervous fibres directly from the anterior or motor roots of the third, fourth, and fifth sacral nerves; and it is more abundantly supplied with nervous filaments than is the muscular coat of the organ. That the sphincter vesicæ is under the control of the will is therefore apparent from the anatomical characters, since a strand of fibres connects the peduncles with the motor centre of the bladder in the spine, and this centre connects with the sphincter through the spinal nerves. In normal urination the sphincter is relaxed by the volition of the individual, while the muscular coat of the organ, being under the control of the sympathetic system and involuntary in its action, expels the urine as soon as the sphincter is open.

The pudic nerve also sustains an important relation to the function of the bladder. Arising from the sacral plexus, it is distributed "to the base of the bladder, the prostate, the integument of the penis, scrotum, and perineum, the urethral muscles and mucous membrane, and the sphincter of the anus;

in the female, the uterus, vagina, and vulva are s
same nerve." Knowledge of the distribution of
to understand the manner in which disease or
genital organs and anus disturb the functions
of the inferior branches of this nerve affects t
branches, or those which supply the base of the
muscles, so as to produce in certain patients d
both.

Etiology.—In all cases the urine should be
of the enuresis is often discovered in the deviati
state which are apparent on inspection. The chi
as follows, but often two or more of them are

1. Too great acidity of the urine. The urine
from the presence of the acid phosphate of sodi
conditions the acidity becomes so great that the
to the surface of the bladder. Now, stimulating
the bladder to contract, just as an irritating s
increases the peristaltic and vermicular moveme
sive acidity of the urine is commonly due to
resulting from decomposition of the urates; but
and hippuric acids, resulting from faulty diges
(Robin); urine unduly acid renders its retention
erate quantity, so that enuresis results.

2. Increased quantity of urine. This someti
use of liquids, as of water or milk. Renal dise
gerated excretion of urine, sometimes produces
"I would advise you never to omit an examina
cases of diabetes mellitus and chronic nephritis a
manifested by nocturnal incontinence."

3. A vesical calculus. This is an infrequent
is likely to produce both diurnal and nocturnal e
frequent and painful by day and by night, if
amount of mucus or muco-pus so as to render it
and frequent urination be not soon relieved by tre
ably present. In such cases the bladder should,
the proper instrument to render diagnosis certai

4. The muscular coat of the bladder may have
power in itself, and not imparted to it by any extr
The surrounding conditions may be normal, while
tive, so as to contract with undue energy by ordin
is in the bladder itself, whose functional activity is
be the most common cause of enuresis in children.
bladder which Trousseau had in mind when he
nocturnal incontinence of urine is a neurosis, and
osis manifesting itself by excessive irritability o
immediate cause of incontinence is this excess of
fibres of the bladder." As Bretonneau pointed
from this cause habitually pass urine in a full and
in less time than other children, showing that th
muscular coat is in excess. From the fact that b
patients, we infer that irritability of the muscula
of enuresis in children, since this agent acts by
tractility.

5. Weakness of the muscular fibres which con

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[1] *Diseases of Children*, p. 257

bladder. Diminished tonicity of the sphincter muscles does not occur, or it occurs very rarely in those who have had previous good health and are robust. Ordinarily, children affected by enuresis from this cause are in habitual ill-health. They have had long and prostrating sickness, which has diminished muscular tonicity, or they have local disease in the spine or in the course of spinal nerves, which has impaired the innervation of the sphincter. Sometimes incontinence of feces is also present, and examination of the sphincter ani by introducing the finger shows that its contractile power is insufficient. We infer the presence of atony of the sphincter vesicæ from the atony thus easily discovered of the sphincter ani. As an example of enuresis from atony of the sphincter vesicæ, we may mention the case of a boy of thirteen years who had "a flat, doughy tumor" at the lower end of the dorsal vertebræ, in the middle of which a deficiency in the bony arch which covers the spinal cord was detected by the fingers, showing that the tumor was a spina bifida containing a considerable amount of adipose and granulation tissue. The congenital deficiency in the spinal column, and consequent injury of the spinal cord, had produced incontinence of both urine and feces.

6. We have already, in speaking of the distribution of the pudic nerve, alluded to the fact that enuresis in children is not infrequently produced through reflex action by disease or an abnormal condition external to the bladder in parts which receive their nerves from the same source as the bladder. Henoch says: "Occasionally congenital phimosis, stricture of the urethra, irritation of ascarides, fissure of the anus, onanism, or vulvitis can be detected, upon the removal of which the enuresis ceases." Trousseau relates the case of a young man of seventeen years who from childhood had been in the habit of wetting the bed two or three times every night. After unsuccessful trial of belladonna, strychnia, and mastich, it occurred to Trousseau that the infirmity might be due to congenital phimosis, and accordingly Professor Jobert circumcised him. With the exception of three consecutive nights he was entirely relieved of enuresis during his subsequent stay of nine months in the hospital. In dispensary practice in New York City we find preputial adhesions, with the accumulation of smegma between the glans and foreskin, and more or less balanitis—a common cause of disturbed function of the bladder. The dysuria and enuresis cease when the adhesions are divided by the probe, the smegma removed, and the preputial inflammation or irritation has abated.

7. A psychical cause, to which Bartholow alludes. The patient dreams that he is in a convenient place for urination, the desire of which is impressed on his thoughts, and awakens to find that he has urinated in bed. Since the action of the bladder is largely under the control of the will, a strong will or determination, if the patient be not too sound a sleeper, does exercise a controlling action over the bladder even during sleep. We sometimes observe this effect of will-power in the fact that the patient breaks the habit of enuresis through a sense of shame or by a determination to avoid the disgrace. Thus one writer mentions the case of a girl in whom severe flogging by her mother put a stop to the habit, and patients sleeping away from home, as when visiting among friends or at a boarding-school, sometimes break the habit through an effort of the will. The sense of profound shame which the infirmity produces thus enables certain patients to control the action of the bladder even in sleep. The state of the mind should therefore be considered as an element both in the causation and cure of the infirmity.

8. Malformation of the bladder or its appendages. These are of various kinds. Some of them are of such a nature that cure of the enuresis is difficult or impossible. Thus, Thomas U. Madden, M. D., F. R. S. C. E., relates the case of a young lady who had been treated by different physicians in

various localities with belladonna, iron, vesication
usual remedies, without the least benefit. The
stant day and night, so that she was debarred fro
avoided by her associates. She was placed unde
der was found to have the power to retain a con
Pursuing the examination, Dr. Madden found tha
small orifice about half an inch above the meatu
rugæ of the mucous membrane. A No. 1 cath
tire length through the opening, so that, in the o
was malposition and elongation of the right urete
ing into the bladder, discharged the secretion o
vulva. In malformations like the above, as well
vesical or vesico-vaginal fistula, the result of ab
the urine obviously dribbles constantly and from
perpetual lifelong dribbling a malformation or con
pected, and is probably the cause.

PROGNOSIS.—The prognosis depends on the ca
sis. Most of the causes are of such a nature tha
the majority of patients can therefore be cure
Enuresis due to irritating properties in the urin
tion in the genital organs or rectum, and that due
the muscular coat of the bladder, can be for t
by appropriate measures, while that resulting fro
spinal cord or from malformations in the urina
to treatment.

It is the common belief that those epochs in l
change in the individual, as puberty or marriage,
in cases previously obstinate. This opinion is t
on fact. The development of the sexual organs
the bladder less irritable and more retentive in so
related, as one by Trousseau, in which incontin
and pregnancy. But treatment in the ordinary
be deferred in the hope that time and physical
for this belief is likely to be illusory.

TREATMENT.—The physician asked to presc
should carefully examine the patient in order to
the most common cause is irritability of the bl
the bladder itself or imparted to it by the stimula
the urine should be rendered as bland and unirrit
be made, so far as possible, as bland and unirrita
is best accomplished by rendering it neutral. Ex
so common a cause of enuresis, is promptly rem
administered in doses of a few drops largely dilut
and efficient remedy in the treatment of this in
unduly irritable. If, therefore, in the examinati
cause of the incontinence except an exaggerat
bladder, and the urine is acid, from three to five
should be given three or four times daily in a
until litmus-paper shows that the urine is ne
should be maintained.

In belladonna we possess an agent which dim
ity of the bladder when the latter is in excess.
tile power of the muscular fibres, and its use is
class of cases which we are now considering. I
of belladonna is more commonly employed than

in Europe, especially in continental Europe, and if obtained from a good laboratory its action is as certain as that of the extract, while its dose can be better regulated. Five drops of the tincture may be given every evening or, if the enuresis be diurnal as well as nocturnal, every morning and evening, to a child of five years, and the dose be increased by one drop every second day if improvement do not occur and physiological effects are not produced, until the dose is doubled or even trebled. If the enuresis be relieved, or if, without its relief, physiological effects be observed, as dryness of the fauces, cutaneous efflorescence, or dilatation of the pupils, the dose should not be increased. When belladonna produces the desired effect, it is no doubt best to continue its use for some weeks in the dose which is found to be effectual, and then to diminish the number of drops gradually.

Trousseau, who, as we have seen, considered enuresis in most cases a neurosis, highly extolled the treatment by belladonna, believing it the most effectual of all methods of cure. He prescribed the extract of belladonna, gr. $\frac{1}{7}$, or the sulphate of atropia, gr. $\frac{1}{140}$, but he did not state the age of his patients. The dose was increased if necessary, and whatever dose he found to give relief he administered once daily for three, four, or five months, after which it was gradually diminished, but it was not discontinued until after the lapse of two to ten months. By this treatment Trousseau states that a majority of his cases were signally benefited, and not a few were entirely relieved. The following case, which recently occurred in my practice, indicates the mode of treatment in enuresis when it results from the cause which we are now considering: L——, aged eleven years, male, had diurnal and nocturnal enuresis, which seriously interfered with his comfort and rendered him an object of aversion and ridicule among his schoolmates. He had previously taken belladonna and other remedies without improvement. His urine was found highly acid. Five drops of liquor potassæ were ordered to be given three or four times daily, and the tincture of belladonna, to which he was accustomed, was administered in nine-drop doses three times daily, to be increased, if need be, to fourteen or fifteen drops. The liquor potassæ, in the dose mentioned, immediately rendered the urine neutral, and the enuresis from that time ceased. The treatment recommended above, of rendering the urine as little irritating as possible by neutralizing it, aided by belladonna, which diminished the contractility of the muscular fibres, cured the infirmity, which had been most troublesome and tedious.

If the enuresis be due to an abnormally large secretion of urine, the cause may be such that something can be done to relieve the patient. The liquid ingesta in the latter part of the day should be restricted. If it be found that the increased flow is due to diabetes or chronic nephritis, the enuresis, though an unpleasant symptom, is comparatively unimportant, and the grave disease which causes it requires chief attention. The quantity of urine may be diminished in diabetes mellitus by the use of proper food, and in diabetes insipidus by ergot.

Enuresis due to a vesical calculus is associated with symptoms, as we have stated above, which indicate the presence of stone, such as painful micturition, which may awaken the patient at night, and thus prevent the accident of which we are treating. Urination more frequent and painful in the daytime than at night, occasional interruption in the stream of urine from the impediment, pus, perhaps blood and an increased amount of mucus, in the urine, indicate the presence of a stone. Fortunately, the calculus is easily detected by sounding, and by the present improved instruments it can be crushed and removed, or it can be removed by lithotomy, which in the opinion of some is less dangerous, and is preferable to crushing when the patient is a child.

As we have stated above, the physician should always examine parts contiguous to the bladder, as the genital organs and rectum, in order to ascertain if there be any source of irritation in them which may produce irritability of the bladder by reflex action. In some instances, as we have seen, enuresis rebellious to ordinary treatment ceases when the irritation in part contiguous to the bladder is removed. Phimosis, preputial adhesions, th accumulation of smegma between the foreskin and glans, with more or les balanitis produced by the foul products, and vulvitis, or ascarides, should, if present, receive treatment, and with the removal of the irritating cause th enuresis will probably cease.

Cases in which preputial irritation produces an irritable state of the bladder are not infrequent among the poor of New York, whose habits are frequently degraded and filthy, and the treatment consists in dividing adhesion of the glans to the foreskin, cleaning away the smegma, and using a soothing ointment. The foreskin can, with few exceptions, be sufficiently stretche for this purpose, so that incision (or circumcision, which is frequently performed in these cases) is unnecessary.

If the enuresis be due to atony of the sphincter, a remedy is require which acts very differently from belladonna. If weakness of the sphincte be the cause, the indication is obviously to increase its tonicity, and the tw medicines which have been most successfully employed for this purpose ar nux vomica (or its active principle strychnia) and ergot. We have state that the sphincter is more abundantly supplied with nerves than is the muscular coat of the bladder, so that those agents which restore innervation, an thereby increase muscular tonicity, act upon the sphincter more powerfull than upon the muscular coat. Ergot appears to exert a similar actio though perhaps less in degree, upon the sphincters of the bladder and anu to that which it exerts upon the uterine muscular fibres.

We can obtain a clearer idea of the effect of therapeutic agents upo paresis of the sphincter vesicæ by observing their action in paresis of th sphincter ani, for these two sphincters suffer a loss of power from the sam causes, and recover it by the use of the same agents.

In a very instructive paper on incontinence of feces, published by D George B. Fowler in the *American Journal of Obstetrics* for October, 188 two cases are detailed, showing unmistakably the beneficial action of ergot i increasing the tonicity of the sphincter ani; and the same treatment is ind cated for urinary incontinence when it arises from a similar cause. A chil of seven years, in the practice of Dr. Fowler, had been closely confined t his studies, with probably some deterioration of his health, when fecal inco tinence commenced. The tonicity of the sphincter ani on examination wit the finger did not seem much impaired. Nevertheless, it was so increased b ten-drop doses of the fluid extract of ergot that the incontinence was relieve The second patient, an anæmic girl of thirteen years, had been under trea ment with iron and other tonics without benefit to the fecal incontinenc Her flesh was flabby and surface cool, and, which is interesting to remark a throwing light on the condition of the vesical sphincter when it lacks ton city, a lack of resistance in the anal outlet was very apparent to the touc A mixture containing 15 minims of the fluid extract of ergot and grain $\frac{1}{16}$ of strychnia was given three times daily. At the end of the first week sh had only two recurrences of the trouble, and in three weeks was cure Four months afterward, although she had been taking quinine and iron afte the discontinuance of the ergot, a partial relapse occurred, and a suppositor of five grains of ergotin, with butter of cocoa, was employed morning an evening. Immediate relief followed, the tonicity of the sphincter wa restored, and the suppositories were discontinued after two weeks. Th beneficial effects of ergotin in weakness of the sphincters is shown by these cases. Enuresis from weakness of the sphincter vesicæ could not have been better treated than by the same remedies which relieved the fecal incontinence in these two patients.

A considerable number of medicines which are now seldom used have been employed with more or less success for enuresis. According to Bouchut, M. Ribes was the first who prescribed nux vomica. The patient was a soldier who had both urinary and fecal incontinence, and was cured of the weakness of the bladder in five days. Nux vomica is employed instead of strychnine, as its use involves less danger. Mondiere prescribed this agent in combination with the black oxide of iron in the following formula:

℞. Extracti nucis vomicæ, gr. vj;
Ferri oxidi magnetici, ʒj.
Ft. pil. No. xxiv. Take one pill three times daily.

Although we accept the statement of Bouchut that strychnia is an "extremely dangerous" remedy for enuresis if the patient be under the age of four or five years, yet over that age it can be safely prescribed as an adjuvant to the ergot in proper dose and with proper precautions. A small dose, repeated after three hours, is obviously safer than a larger dose at longer intervals.

Among the remedies not yet mentioned which have been successfully employed in certain cases, the tincture of cantharides requires notice. In large doses this drug causes strangury, but in small doses it produces such irritation or stimulation of the surface of the urethra as to increase the contraction of the sphincter and awaken the patient when the urine presses upon the urethral orifice, which is rendered sensitive by this agent. Cantharides is an unpleasant remedy, and it is not much employed of late years; probably the benefit from its use is not usually permanent. A child of five years can take four or five drops, largely diluted with water, three times daily, and the dose should be gradually increased until there is some evidence of its effect on the outlet of the bladder.

Cubebs, recommended by M. Dieters, the various vegetable tonics and astringents, iron, creasote, and many other remedies, have fallen into disrepute and are now seldom used. Sometimes certain combinations of remedies give prompt and entire relief. Eustace Smith says: "I have lately cured a little girl, aged four years, who had resisted all other treatment, with the following draught, given three times daily:

"℞. Tinct. bellad., ʒj;
Potas. bromidi, gr. x;
Infus. digitalis, ʒij;
Aquæ, ad ℥ss. Misce.
Ft. haustus."

The tincture of belladonna of the British Pharmacopœia has about half the strength of that employed in the United States; but even with this allowance I would not dare to prescribe so large a dose of this agent, except that smaller doses were first used and tolerance of the remedy demonstrated. Of the tincture of belladonna of the U. S. Pharmacopœia ten minims would be a large dose.

Local treatment has been attended by a degree of success. The neck of the bladder and the urethra have been cauterized by the nitrate of silver applied by the porte-caustique of Lallemand, with some relief of the enuresis, at least so long as the soreness remained. Baths and douches of cold water have also been used by many physicians, some of whom, as Underwood, Baudelocque, Guersant, and Dupuytren, sta good results. This treatment is most beneficial i sphincter is relaxed.

Finally, in certain patients the advice of Trous the patient in the daytime resist the inclination does not greatly increase his or her discomfort; b ance of the presence of urine in the bladder is pr

CALCULI; DYSURIA; CRYPT

We have seen, in our remarks on Uric-Acid I form in the pelvis of the kidney, first as small con ing to the bladder, they may become nuclei wl accretions to their surfaces, or they may form pr vesical calculus is not very infrequent, even in t ence is manifested by dysuria and increase of mu pus and sometimes of blood-cells in the urine. urine is obstructed by the presence of the cal tenesmus causes prolapsus ani. Prolapsus ani symptoms of stone in the bladder. Sometimes tl distended with urine, and there may be trickling ness of the prepuce and adjacent parts. Now an the urethra, producing more or less retention of prepuce and adjacent parts. The treatment for surgical. Lithotrity as now performed with impr of danger and successful. If a stone lodge in th its outer extremity, where the canal is narrowest, pair of small forceps.

Dysuria occurs from various causes. It not but also from urine concentrated and acid. We h containing uric acid and the urates, if they are ab and while this acid and its salts increase the fre are likely to render it painful. They sometime spasmodic contraction of the muscular fibres in transient albuminuria has been noticed. Dysuri treated by alkaline and mucilaginous drinks.

Dysuria not infrequently arises from a morbid itals, and they should always be examined when obstructed to ascertain their condition. In the life the prepuce is usually adherent to the glan which appear to arise from the rete Malpighii, and remain soft and filled with protoplasm. This adh must be considered normal, especially as it does But occasionally, even in young boys, a patholog which gives rise to symptoms, among which is present, retarding the flow of urine, some of wh foreskin, where, decomposing, it excites balanitis, ca urination painful. Circumcision gives relief to dysuria. In the Out-door Department at Bellev siderable number of cases of this kind have been has rarely been necessary to circumcise or slit the the adhesions are divided by a probe, the prepuce so as to expose the glans, and the parts thorou ointment; if there be much inflammation and sw to etherize the patient for the operation.

In young girls the labia minora are often adhe catarrhal inflammation. They can, for the most part, be readily separated by traction, when minute drops of blood appear upon the exposed surfaces, showing that a vascular connection has already occurred. Henoch[1] says: "In a few cases this adhesion appears to me to be the cause of dysuria, which disappeared after the separation of the labia from one another; in others examination showed inflammatory redness of the introitus and meatus, with increased secretion of mucus, which renders the excretion of urine painful." Separating the adherent parts and covering the surface with simple ointment to prevent readhesion suffice to effect a cure of the dysuria when it depends upon this cause.

In the first months of fœtal life the testes lie in the abdominal cavity in front of and a little below the kidneys, behind the peritoneum, and attached to the base of the scrotum by a long cord, the gubernaculum testes. Between the fifth and sixth months the testes descend to the iliac fossa, with corresponding shortening of the gubernaculum. At the end of the eighth month it has descended into the scrotum, surrounded by a pouch of the peritoneum, which becomes detached from the peritoneum "just before birth" (Gray), forming a closed sac, the tunica vaginalis. It is estimated that in one case in five the descent of the testicle is delayed from a few months to a year after birth. Astley Cooper states that the descent does not occur in some cases until between the thirteenth and seventeenth years. When there is this late descent intestine is apt to follow the testicle, causing inguinal hernia. In about one case in one thousand, it is estimated, the testicle does not descend, but remains in the abdominal cavity, either on account of adhesions to the abdominal viscera, the small size of the ring, or some defect in the gubernaculum. Occasionally, a retained testicle has the normal structure and development, but, as a rule, it is imperfect and small, like the testicle of the infant, and it is prone to fatty or fibrous degeneration. If both testicles are retained, impotence may result on account of the non-development or degeneration. No treatment is required for the retained testicle, unless it become inflamed when lying in the inguinal canal, when it should be treated by poultices and other soothing remedies.

VULVITIS.

Inflammation of the vulva is common in girls under the age of five years. Like most other inflammations, it varies in severity in different cases, from a mild and transient attack to one attended by tumefaction and excoriation or ulceration of the labia, pain, and abundant discharge. Ordinarily, when the physician is consulted, the disease has continued a few days, and he finds the vulva moist from a muco-purulent discharge, which dries into light yellow crusts and produces greenish or yellowish stains on the under-clothes. The vulva and lower part of the vagina are sensitive and red, and the acrid secretions sometimes cause redness of the skin over which they flow. Frequently the labia are swollen and tender, the patient may complain of soreness from friction in walking, and sometimes dysuria occurs from extension of the inflammation into the urethra. In severe cases ulcerations or erosions upon the labia result, increasing the distress of the patient.

Vulvitis is sometimes *aphthous*. Small rounded elevations appear upon the vulva and ulcerate, and the adjacent surface is red and more or less swollen. The ulcers are sensitive and painful, but under ordinary circumstances they progressively heal. Rarely, in those who are markedly cachectic the ulcers become gangrenous and recovery is tedious and uncertain.

ETIOLOGY.—The most common cause of vulvitis appears to be uncleanli-

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[1] *Diseases of Children*, 1882.

ness, and hence its frequency in the families of
cities. The collection of dirt and sebaceous mat
irritation to which it gives rise, which prompts t
the parts, cause inflammation. Struma strongly p
tion, so that slight irritating causes develop it in
esis. A considerable proportion of those who
had other manifestations of scrofula and present
it seems proper to consider the inflammation of the
circumstances as possessing a strumous character
the strumous diathesis. We therefore, with Dr
important predisposing cause of vulvitis in the chi
have long been recognized as a cause, producin
itching which prompts the patient to rub the part
It is said that ascarides sometimes crawl to the v
tion by their presence upon the sensitive surface.
cause is infection by gonorrhœal pus. Every ph
dispensaries or tenement-houses of our large citi
three or four years, in whom vulvitis has this ca
rhœa is communicated criminally; in other inst
the infected seat of a privy or from soiled towel
whom I attended was under treatment for gono
of about four and six years were infected by the
soiled towels. The anatomical characters do no
between gonorrhœal and non-specific vulvitis, b
may be made by observing the gonorrhœal micr
one and its absence in those of the other. In
muco-purulent secretion and the inflammatory
danger of infecting the conjunctiva and producin
inoculation with the secretion of vulvitis is well
it is believed by some that vulvitis is occasionall
vulva with the muco-pus of ophthalmia.

TREATMENT.—The parts should be frequentl
mucilaginous water to ensure complete cleanline
mild astringent employed with a syringe, suffices
immediate improvement, and in a few days to e
tions of tannin or alum (5 : 100), sulphate of
silver (1 : 100) have been employed with goo
have obtained benefit from the following mixtu
ommend it than any other:

℞. Zinci sulphat., ℈
Plumbi acetat., ℈
Tinct. opii,
Tinct. catechu, *āā.* fʒ
Aquæ, ad fʒ

To be injected warm four or five times daily thr
percha syringe. The same should be applied w
the external parts. The following are also usefu

℞. Ext. opii aq.,
Liq. plumbi subacetat. dil.,

℞. Pulv. zinci oxid.,
Acidi tannic.,
Mucil. acaciæ,
Aq. rosæ,

If ascarides be present, a cold rectal enem
water should be used daily. Benefit may be obta
simple cold water even when ascarides are not pr

SECTION V.

SKIN DISEASES.

CHAPTER I.

ERYTHEMATOUS DISEASES.

UNDER this head are included erythema, roseola, and urticaria. They consist in active congestion—inflammatory, it is believed—of the skin, which soon declines, with or without slight furfuraceous desquamation. The color of the affected cuticle is bright red in erythema, rosy in roseola, and pale red in urticaria. Febrile symptoms often precede for a few hours the occurrence of the eruption, and they abate as it appears.

ERYTHEMA.

The eruption of erythema occurs in patches of different sizes, the largest ordinarily not exceeding four or five inches in diameter, and most of them have considerably smaller dimensions, their margins being in some instances diffused, and in others circumscribed and well defined. The patches are slightly swollen from engorgement of the capillaries of the skin and slight serous effusion, and are accompanied by a sensation of heat and itching.

Erythema is idiopathic or symptomatic. The *idiopathic* form is subdivided into erythema simplex, intertrigo, and læve. Erythema simplex is produced by external agencies of an irritating nature, as heat, cold, friction, chemical and mechanical irritants, applied to the skin. A common example of this form of the disease is the efflorescence about the anus in cases of infantile diarrhœa, due to the acidity of the evacuations. Erythema intertrigo is produced by the friction of opposing surfaces of the skin, and it therefore occurs mainly in the folds of the neck, about the groins, and behind the ears. This inflammation is sometimes slight, disappearing in two or three days with proper treatment; in other cases the epidermis becomes denuded, the surface is tender and moist, and even superficial excoriations occur. In severe cases the ulcers extend more deeply and give rise to considerable purulent discharge, the skin and even subcutaneous connective tissue being more or less infiltrated and indurated. The confinement of the perspiration, and the moisture which is exuded between the folds of the skin, increase the inflammation. The effused liquid does not in ordinary cases stiffen linen, as in eczema. Erythema læve is the name applied to the inflammatory hyperæmia of the skin which often occurs over œdematous parts. Its most common seat is about the ankles and upon the legs. In children it is most frequently observed in the œdema which results from scarlatinous nephritis and from heart disease.

Symptomatic erythema, which occurs from a general or constitutional cause of a pyrexial character, has several subdivisions. The simplest and

mildest form of it is erythema fugax, which con
erythema which appears upon the features in ac
example. It is common in various inflammator
the erythematous patch be circular, with norm
sometimes designated erythema circinatum and, if
marginatum. Erythema papulatum, tuberculatu
to the same form of the disease, one or the other
ing to the stage or size of the eruption. In eryth
begins as small red spots, which soon become pa
ing from that of a pin's head to a split pea. It o
breast, arm, and back of the hand, and fades a
tion, in about three weeks. In erythema tube
eruptions have a greater diameter and are us
the latter variety they often have a diameter
occur most frequently upon the anterior aspect of
of erythema, which may be described as one, oc
Erythema tuberculatum is most common in serva
from the country. The tumefaction is due to t
corium, and, when the eruption has considerable
cutaneous connective tissue. The color is at firs
or purple, and it fades away like the discoloratio
declines. Rheumatism is often, and diarrhœa
these forms of erythema, and rheumatic pains
well as more or less fever.

Prognosis.—This, as regards the erythema, i
able result in any case is due to cachexia or so
duration of the milder cases is only a few hours,
type, as erythema nodosum, last two or three we

Diagnosis.—The ordinary forms of erythema
sipelas by the absence of any very decided burni
the integument and tendency to spread, and b
symptoms. In those cases of erythema in whi
swelling of the skin and subcutaneous connective
tinguished from those of erysipelas by being mu
and painful, not extending, and presenting as th
of a bruise. In urticaria the wheals, that come
liar stinging sensation, and the irritability of the
these wheals are produced by slight friction, dif
toms and appearances of erythema that the differ
easy. In roseola the eruption ordinarily occurs
entire surface, in points and small patches with
presenting a rosy instead of a bright-red color—
distinguish it from erythema. Erythema when
taken for the scarlatinous eruption, but the re
constitutional symptoms, vomiting, persistence o
distinguish the latter from the former affectio
proper to defer the diagnosis for a day or two,
matous it will fade. Erythema sometimes occur
ola, when, on account of the grave general symp
scarlatina. I have more than once known this
hurried visits of the physicians in former time
common than at present. A more careful exa
error. There is little danger of confounding er
various papular, vesicular, or pustular skin dis

Treatment.—Erythema fugax requires n

occasional dusting the surface with lycopodium or powdered starch. Those forms of erythema which are due to mechanical or chemical irritants soon disappear when the cause is removed. In erythema around the anus, produced by the irritation of the urinary and alvine evacuations, the diaper should be changed as soon as soiled, and if the stools be frequent and acid the alkaline treatment proper for the diarrhœa is useful also for the erythema. In ordinary erythema, as well as in erythema intertrigo, the following prescriptions for external use will be found beneficial:

℞. Zinci oxidi,	℥ss;	
Pulv. calaminæ præp.,	℈iv;	
Glycerinæ,	℥ss;	
Liq. calcis,	℥vij.	Misce.

Or,

℞. Lycopodii,	℥ss;	
Pulv. bismuthi subnit.,	℥iss.	Misce.

℞. Pulv. zinci oxidi,	℥ss;	
Lycopodii,	℥iss.	Misce.

To be frequently dusted upon the inflamed surface.

Or,

℞. Acidi salicylici,	gr. v;	
Bismuthi subnitratis,	ʒij;	
Corn starch,	℥iss;	
Ung. aquæ rosæ,	℥j.	Misce.

In obstinate cases the application three or four times daily of diluted lotio nigra will frequently be followed by immediate improvement.

Potassium chlorate internally, to correct the acidity of the transpiration from the skin in protracted and obstinate cases, and in certain instances cod-liver oil and the syrup of iodide of iron, are called for. If the derangement of the system upon which the erythema depends appears to be of a rheumatic character, the sodium salicylate or alkalies may be required. Erythema papulatum, tuberculatum, and nodosum occur most frequently in reduced states of the system, and therefore need tonics.

ROSEOLA.

The term "roseola" is applied to rose-colored spots or patches of greater or less extent, accompanied by a degree of febrile reaction and often by redness, with little or no swelling of the faucial surface. It is attended by a sensation of warmth and slight itching. The following groups and subdivisions embrace the recognized varieties of this disease:

ROSEOLA.

Idiopathic.	Symptomatic.
Infantilis.	Variolosa.
Æstiva.	Vaccinia.
Autumnalis.	Miliaris.
Annulata.	Rheumatica.
Punctata.	Arthritica.
	Cholerica.
	Febris continuæ.
	Syphilitica.

The color of the eruption gradually fades from a rose-red to a duller hue, and often disappears in two or three days. In other instances the eruption lasts a week or more. Roseola may occur in any season, but it is most com-

mon, especially the idiopathic form, in the warm
the idiopathic disease which are designated infan
are the most common in early life. They are in ı
and may be described as one disease.

SYMPTOMS.—Roseola infantilis, æstiva, or
appearing upon the arms and legs, or general. I
languor, and, in those old enough to describe thei
back, and limbs. There is a great difference, l
regards the severity of the prodromic sympton
so slight as scarcely to be appreciable. Occa
or other symptoms of derangement of the dige
precede the eruption. ·

The eruption of roseola, when general, usuall
the neck and face, and in the course of twenty-fo
upon the rest of the surface. It bears consider
measles. The patches are irregular in shape,
diameter, and, though of a rose color at first, th
as they begin to fade; by pressure the redness
of cases the eruption has nearly faded by the fi
faucial surface, together with the itching or ting
sidence of the rash.

Roseola annulata is a rare disease. It co
symptoms, which are slight or pretty severe, and
tion appears; this occurs in the form of red cir
the diameter of an inch or thereabout, and assum
healthy skin. The rash fades in a few days, oft
ance. The ordinary location of this form of er
and about the thighs. In roseola punctata the
it occurs upon a large part of the surface.

Symptomatic roseola, which appears in the
need only be alluded to. The diseases in which
exception of syphilis, chiefly of an acute febril
This eruption is often really, as stated by Tilb
thema, but in other instances it presents the ty
roseola. Thus I have known it to occur about
vaccinia in rose-colored spots over the whole
anxiety on the part of parents lest impure vi

CAUSES.—These are in a measure obscure.
infancy and the active cutaneous circulation no
and erythema, and hence the frequency of thei
and inflammatory affections. Summer weather,
system which it produces, has been in my experi
of idiopathic roseola in young children in this c
in that of 1868, a large proportion of the infa
and I have been led to consider it a favorable pr
diarrhœal affections which are so common in the

PROGNOSIS.—Roseola is always a mild and f

DIAGNOSIS.—Roseola is distinguished from
catarrhal symptoms, a less degree of fever, less
eruption, and the absence of the history of co
guished from erythema by the smaller size of
dusky-red color. The boundary-line, however,
not well defined, and certain forms of roseola m
The general but punctiform efflorescence, increas
of pulse, and the peculiar appearance of the ton

tinguish scarlet fever from roseola. There is little danger of confounding roseola with urticaria, since the wheals of the latter appear in no other disease.

Treatment.—This is simple. If roseola occur in connection with gastro-intestinal derangement or disease, the remedies which relieve the latter exert a curative effect upon the former. In all cases the state of the system should be inquired into, and any departure from a state of health corrected. Roseola needs no further constitutional treatment. If there be itching or tingling of the surface, a lukewarm lotion, containing equal parts of liq. ammon. acetat. and mistura camphoræ, has been recommended, or a lotion containing a drachm of hydrocyanic acid to a pint of an emulsion of bitter almonds, used warm. The purpose of such lotions is simply to relieve the unpleasant sensation. Cold applications or others which would repel the eruption should be avoided; such an effect might be injurious. In case of acidity of stomach alkaline remedies are useful, and in certain cases tonic treatment is indicated.

Urticaria.

The name by which this disease is designated is derived from the term *urtica*, the nettle, the sting of which produces this form of eruption. The eruption occurs suddenly in wheals or pomphi, attended by tingling and burning, and suddenly disappearing. Urticaria is often accompanied by no very decided general symptoms, but in some patients more or less fever and lassitude occur, with perhaps epigastric pain and headache. The wheals may occur over the whole body, but more frequently are confined to a portion of it. Their shape may be round, oval, irregular, or band-like, and their length varies from a few lines to several inches. In one affected by urticaria the wheals can be readily produced by scratching or rubbing the surface. The eruption is thus clearly described by a recent writer: "At first a bright flush appears; the centre of this becomes slightly elevated and pales, hence appears of lighter color; the tint may be rosy, but more generally it is whitish." The margin of the wheal, the diameter of which varies, always remains red. This eruption appears to be produced by active congestion of the cutaneous capillaries, some serous effusion, and spasm of the muscular fibres of the skin. The effusion of serum in certain localities is quite apparent from the œdema which occurs. The subsidence of the eruption is without desquamation. Urticaria is ordinarily an acute disease. It is sometimes chronic in the adult, but rarely so in children. Several varieties of it are described by dermatologists, according to the cause, appearance, and duration.

Causes.—These are external and internal. Various irritants apart from the nettle applied to the surface produce the wheals, as the bites of certain insects and sometimes turpentine. The following are the principal internal causes, as summarized by Hillier: 1st, profound and sudden mental emotion; 2d, certain articles of diet, as shell-fish, pork, sausage, cheese, etc.; 3d, certain medicinal substances, as copaiba, valerian, and turpentine; 4th, intestinal worms, though it is probable that these seldom operate as a cause; 5th, uterine ailments, as hysteria.

Prognosis; Diagnosis.—The prognosis is good, though the chronic form is sometimes tedious and troublesome. The occurrence of the wheals and the possibility of producing them by friction serve to distinguish this disease from all others.

Treatment.—In urticaria due to recent ingesta of an irritating or indigestible character an emetic of ipecacuanha is useful, followed by a saline, and better also an alkaline aperient, as Rochelle salts. An aperient of this kind is useful ordinarily in acute cases attended by febrile reaction.

The diet for several days should be simple and su
fresh beef, bread, or other farinaceous food, a
wheals appear periodically, when a few doses of q
After the above measures have been employed
whether tonic or otherwise, depends on the condi
benefit accrues from local measures. Sponging
to which a little vinegar is added relieves, in a
ling of the wheals.

CHAPTER I

PAPULAR DISEASES

STROPHULUS.

THE three papulæ—namely, lichen, prurigo,
characterized by small and firm elevations upon t
but the two former are not common, and as they
tial particular from the same diseases in the adul
of in this connection. Strophulus, on the other
to children. It is known as the red gum or w
appearance, and also as the tooth rash. The c
parts which are exposed, as the face, neck, and ex
in some patients of the size of, or even smaller t
other cases they are as large as a millet-seed.

The varieties of strophulus described by derm

S. intertinctus,
" confertus,
" albidus,
S.
"
"

The following are the characters of these var
ules bright red, and occurring chiefly upon the ch
hand; often *intertinctured* with blushes of eryth
four weeks and is most common in young infa
numerous and closely aggregated, paler, continui
lus intertinctus, and likely to recur, appearing ab
and most frequently upon the arm. Sometime
become chronic, slowly disappearing and leaving
S. volaticus appears usually upon the arms and ch
dozen (fewer or more) papules, which soon disap
pear at intervals for two or three weeks, and are
ing, though not intense. S. albidus, so called, sho
the diseases of the sebaceous glands and describe
appears in the form of small white elevations as l
monly upon the face and neck, and produced by d
glands with the secreted product. The term stro
to large white papules which appear upon the sid
and arms of infants of one year or thereabouts,
week. They are liable to be associated with the
fertus. S. pruriginosus is really a form of liche
the age of one and under that of eight or nine y

are small and discrete, usually appear over a large extent of surface, ordinarily upon the back, front of the chest, the face and arms, and as they are scratched from the itching, minute dark points of blood collect and dry upon their apices. This form of strophulus is more protracted than the others, and, in consequence of the irritation produced by the scratching, pustules of ecthyma often occur among the papules. The apparent cause of strophulus pruriginosus is a mode of life which impoverishes and vitiates the blood, such as uncleanliness and residence in damp, dark, overheated, and overcrowded apartments. Atmospheric heat also operates as a cause of this form of strophulus, and it is not an infrequent disease in cities during summer months.

The various eruptions included under the term "strophulus" have such different anatomical characters that a proper classification would locate some of them in other groups of skin diseases. One form of it, as we have seen, is produced by distension of the sebaceous glands; in other, and the majority of cases, as appears from the recent observations of Mr. Fox, its seat is the sweat-glands, and in others still the papillary layer of the skin, as in lichen, the papules being produced by an exudation.

TREATMENT.—Personal cleanliness, with frequent change of linen and daily ablution without the use of soap, should be enjoined. Local irritants, which might aggravate or cause the disease, should, so far as practicable, be removed. Alkalies in cases of acidity of the *primæ viæ*, and occasionally mild aperients, are required; the food should be bland but nutritious, and if the child be nursing it may be necessary to attend to the health of the wet-nurse. Favorable hygienic conditions, important for the successful treatment of all forms of strophulus, are especially required in strophulus pruriginosus. Nutritious diet, fresh air, quinine, iron, cod-liver oil, etc. should be prescribed for those affected by it. In strophulus albidus the small round, whitish, sebaceous elevations should be opened by the point of a lancet and their contents pressed out between the thumb-nails or by pressure with a watch-key.

CHAPTER III.

ECZEMA.

THIS is one of the most common maladies of the skin. It constituted one-third of Devergie's cases and one-sixth of Hillier's. In the commencement of the eczematous eruption the skin presents a superficial redness, and upon this inflamed area numerous minute and closely aggregated papules, vesicles, or, more rarely, pustules, appear. These are very fragile, so that they soon rupture, the epidermis is broken and destroyed, and the surface is moistened by an effusion which appears to be serum, and cannot be distinguished from it by the microscope. This liquid when dry stiffens linen. As it dries thin crusts form of a light-yellow color upon most parts of the surface, but they are thicker and of a deeper yellow color upon the scalp than elsewhere. The crusts consist mainly of pus, epithelial cells, and granular matter.

ANATOMY.—Biesiadecki has described the formation of the eczematous eruption. According to him, the papules are produced from the papillæ, which increase in size by cell-formation in their interior. The connective-

tissue corpuscles enlarge, and are unusually "rich
ber increases. Under the microscope spindle-shape
filling the papillæ, and extending up from them
crowding apart the cells of this layer and reachi
dermis. The epithelial cells in the immediate vi
become swollen. This cell-growth produces the

If the cell-formation continues within a papill
ruptured, and as they are very moist a liquid is ef
dermis over the summit of the papilla. This pro
icle. Occasionally pus mixes with this liquid, an
ico-pustular.

In acute eczema the upper part of the true skin
while the lower part is commonly unaffected, excep
The older the eczema the greater the extent of
chronic eczema the whole thickness of the skin is
than in acute forms of the malady. The dischar
face is irritating, and healthy skin with which it m
reddened by it and made eczematous from its irrit
occurring upon a part of the surface which is in
surface of sound skin, commonly affects the latt
stated, a nurse by carrying an infant having eczem
tract the same disease upon her arm, although th
ciple in this malady.

ETIOLOGY.—Eczema is often produced by irrita
the skin. Croton oil, certain soaps, the finger-nails
or belt by pressure, may produce it. Those having
are more liable to it than others. The constitution
It is sometimes obviously due to indigestion or a di
see it occur in nursing infants as a result of sickn
mia and scrofula are occasional causes. Among th
mon, and many of the children who have it are sc
portion show no evidence of struma, and in the l
majority do not.

VARIETIES; SYMPTOMS; COURSE.—Eczema
according to its location, as E. faciei, capitis, e
which has more scientific value, is according to
the eruption, by which we have the following
wit, Eczema papulosum, vesiculosum, pustulosum
and squamosum. A simpler and still more conve
eczema simplex, rubrum, impetiginosum, and sq

Eczema of the scalp is common in infancy, occu
or impetiginosum. The eczematous exudation, mi
of the sebaceous glands, which are numerous upon
yellow crust. It is likely to extend beyond the hai
and around the ears. This extension aids in establis
eczema and certain other cutaneous eruptions of t
external ear is sometimes primary, but in other ins
that of the scalp, and due to extension of the latt
the angle behind the ear and upon the lobe of the e
along the auditory meatus, narrowing its calibre, a
temporarily or even for years. Eczema upon the f
in children from extension of the eruption from the
and chin are often also affected by eczema, which
monly eczema rubrum, and is attended by redness,
itching. The swollen and red appearance, with the c

by scratching, often greatly disfigures the countenance. In children, when eczema occurs upon other parts, it is usually associated with that of the scalp, face, or ears, that in the latter situations being the most severe and obstinate.

Eczema *simplex* is common in the summer months, being produced by the heat of the atmosphere, aided perhaps by other causes. The patient may appear well, or be somewhat indisposed, having febrile symptoms, and soon an erythematous patch of greater or less extent appears, upon which a cluster of the characteristic papules or vesicles soon occurs. These break, forming slight crusts, which are detached and the eczema declines, or it may continue longer, with successive crops of the eruption.

In eczema *rubrum*, since it is a more severe form of the disease, the fever and the local symptoms are greater than in the preceding variety, and the eczematous patch presents the appearance of a more intense inflammation. The papules or vesicles are often so minute as to be with difficulty recognized. They are soon broken, when they form with the secretion and exudation from the surface yellowish or brownish-yellow scabs. The discharge is more irritating, as it is more abundant, than in eczema simplex, and the adjacent skin is usually more inflamed from its contact.

Eczema *impetiginodes* is common in young debilitated children, in whom, in consequence of the cachexia, inflammations, of whatever character, are liable to be suppurative. This form of eczema presents at first the symptoms and features of eczema rubrum, but the transparent liquid of the vesicles soon becomes opaque, from the generation and admixture of pus-corpuscles. The crusts which form from the rupture and desiccation of the vesiculo-pustular eruptions are thick and greenish-yellow, and in infants the sebaceous glands, which are involved in the inflammation, pour out an abundant secretion, increasing the thickness of the crusts. This form of eczema is most common in infancy, and its usual seat is upon the scalp.

DIAGNOSIS.—Eczema presents in different instances so different an appearance that it is not always readily diagnosticated. It will aid in its diagnosis to recollect that it is in its nature a catarrh, affecting primarily and chiefly the upper portion of the derma and the Malpighian layer, and although it may now present a dry or scaly appearance (E. squamosum), yet its history will show that there has been a discharge or moisture. In a large proportion of cases the physician is not able to detect papules or vesicles, since they are fragile and transient, breaking in the first thirty-six hours and not reappearing. Still, when they are absent we sometimes observe around the margin of the patch an appearance which indicates that they have been there. Their minuteness is occasionally such that they may escape notice on a cursory inspection when they are present and well defined. Acute eczema, affecting a considerable extent of surface, is often attended by febrile symptoms, and may be mistaken for one of the eruptive fevers, but the absence of certain distinctive appearances which characterize these fevers, and the speedy appearance of the eruption and moisture, establish the diagnosis. Eczema can be readily diagnosticated from ordinary erythema, which is a superficial inflammation without moisture. The location of erythema intertrigo serves for its diagnosis, as it is evidently produced by the attrition of opposite surfaces of the skin. Moreover, it lacks the elevated papillæ, and the discharge does not stiffen like that of eczema. Lichen, when acute, presents some resemblance to eczema, but it is dry and papular, the papules, though small, being detected by the finger as well as sight. The large and irregular phlyctenulæ, intense inflammation and œdema, and mode of extension of erysipelas; large, scattered, and non-inflammatory vesicles of sudamina; scattered and acuminate vesicles, without surrounding inflammation, of scabies,—are so

different from the eczematous eruption that the
those diseases is readily made. Herpes circinatus
eczema by the circular shape, larger size, and grea
icles, and the delicate, branny scales, which consis
than the product of exudation, as in eczema.

Treatment.—In the treatment of this trouble
ures are more inportant than internal medication,
ful, and indeed necessary, in order to prevent rela
usually begins as an erythema, soon followed by
the patient scratches the itching surface, pustules
surface presents a red and angry appearance, fro
highly irritating watery secretion, mixed perhaps w
ening and infiltration of the skin occurs, and the i
patient cannot refrain from scratching or rubbing,
itching and the consequent restlessness often dep
the mother or nurse, of the needed sleep. The c
fore a matter of great importance, or, if not a con
the suffering. The popular belief, which is also
that the cure of eczema or its sudden disappearan
of the child, causing even convulsions, is witho
sequelæ, if they occur, must be attributed to oth
as coincidences. Hebra, the most distinguished
which he lived, stated, after having treated twe
eczema, that he had never observed any ill-effe

In the treatment of eczema it is a matter of
prevent the infant—for infants are the chief suff
inflamed surface. The method employed by Pr
versity has, I believe, been commonly approved a
dermatologists. He applies a skull-cap of old cot
over the calvarium, and a mask of the same mate
apertures for the eyes, nose, and ears, gathered i
lapping two inches at the back of the head an
mask protect the scalp and face when eczemato
scratching of the child. In a mild case this co
pensed with, or be used only when the child is n
cases it is best to wear it constantly. The object
tation of the inflamed surface by rubbing or sc
aggravates the eczema.

Dr. White also recommends restraint of the
this purpose he takes a small pillow-case with a h
allow its head to pass through. The pillow-case
the body and limbs of the child, and its front a
by stitches or safety-pins between the body and ar
prevents the infant from lifting the hands to the f
from such treatment may seem cruel to the pa
becomes accustomed to it, and suffers less in th
to scratch the inflamed surface, which alway
Whatever ointment is used can be conveniently
mask.

Before considering the details of treatment it
following facts, which will aid in the selection o
requires soothing remedies, and should not, as a
and water. Crusts forming over vesicles shoul
accompanied by itching or purulent or decompos
If so, they should be removed at once by soothing

vesicles form rapidly and are accompanied by severe itching, they may be broken, so that the secretion is released, which may diminish the pruritus. In using mercurial and lead preparations care should be taken not to apply them over an extensive area, since they are absorbed and might produce systemic effects of a toxic nature.

Removal of Crusts.—The crusts which in many cases form upon eczematous surfaces, and under which irritating secretions are confined, increase the itching and restlessness of the child and interfere with the action of local remedies. Oleaginous substances should be used for their removal, as sweet oil or cold cream, and they should be applied in such quantity that they soak thoroughly into the crusts. On smooth surfaces, as the face, a mild ointment like simple cerate, thickly spread on surgeon's lint, may be applied over the crusts, which will to a great extent be detached and removed with the plaster. Salicylic acid has also come into use as a solvent of crusts. The following ointment, rubbed in hourly or applied thickly spread on surgeon's lint, renders the surface clean in a few days:

℞. Acidi salicylici,	ʒj;
Vaseline,	℥iss. Misce.

The first indication has now been accomplished, that of denuding the surface of crusts. The next indication is to cure the disease.

In commencing the treatment of acute eczema the lotio nigra of the Pharmacopœia, consisting of calomel and lime-water, may sometimes be advantageously employed, applied by a large camel's-hair pencil or soft cloth, and followed perhaps by diluted oxide-of-zinc ointment or vaseline. The black wash should be well shaken before being used.

Hebra's diachylon ointment is also soothing and useful for acute eczema, if properly made; but, unfortunately, much of that in the shops is incorrectly prepared and is unsuitable. The following is the correct formula:

℞. Olei olivæ opt.,	f℥v;
Pulv. lithargyri,	ʒi–ʒij;
Aquæ,	q. s. Misce.

The oil is mixed with a third of a pint of water, and heated in a steam-bath to boiling. The litharge, finely powdered, is then sifted in with constant stirring. The boiling is continued until the fine particles of litharge disappear. During the boiling a little water is added from time to time to keep up the original amount, and water remains in the vessel when it is removed from the fire. The mixture is then constantly stirred until cool. The ointment should be made of the best oil and litharge, and when properly made it resembles butter in consistence, and to a certain extent in color, having a light-yellow hue. It should be freshly made when needed, and renewed every week.

Another good ointment for acute eczema is the following, prepared originally by McCall Anderson:

℞. Pulv. bismuthi oxidi,	ʒj;
Acidi oleici,	ʒj;
Ceræ albæ,	ʒiij;
Vaselini,	ʒix;
Olei rosæ,	♏iij. Misce.

This also resembles butter in appearance, and may be applied several times daily.

A considerable number of other soothing ointments have been used and recommended by dermatologists for acute eczema. of zinc or subnitrate of bismuth to one ounce o be employed, but it possesses no advantage over above, except that it is easier of preparation an same may be said of the ointment of the oxide of used in acute eczema than any other ointment. ment, if carefully prepared according to the formu not surpassed by any other ointment for its soothi

Ointments have, I think, given more satisfacti acute eczema, but in the commencement of ecze sum, common powdered starch, talc (magnesium or rice-starch (amylum oryzæ), dusted upon the i some relief.

The following formula is essentially that re glycerin being omitted:

℞. Amyli oryzæ,
Talc. venet.,
Flor. zinci,
Pulv. iridis Florenti, āā.

Camphor may be added to relieve itching in the p

Van Harlingen states that in eczema intertr eczema attended by much burning and itching, bu lowing prescription gives great relief:

℞. Pulv. camphoræ,
Pulv. amyli,
Pulv. zinci oxidi, āā.

To be dusted upon the surface or upon the soft the lint to be applied upon the inflamed part. It raw surface. Carbonate of zinc and subnitrate c dusting-powders for such cases.

Itching is the symptom which produces the ness of the patient: 2 per cent. of camphor add gives some relief to this symptom. A mixture o in water, or ½ to a 2 per cent. solution of alumi said also relieves the pruritus. Carbolic acid, pro most effectual agents to relieve the itching. Bu applications containing water frequently applied a eczema. If the above remedies fail to give relief, child restless, the following formula may be tried:

℞. Acidi carbolici,
Spts. vini Gallici,
Spts. lavendul.,
Eau de cologne, āā.

This can be applied by a camel's-hair pencil. Th might render it more effectual in relieving the itch has also been considerably used in New York, and dermatologists:

℞. Acidi hydrocyan. dil., ʒ
Bismuthi subnitrat., ʒi
Aquæ destillat., ℥

Ft. lot.

By the above treatment the inflammation usually abates, but the eczematous patch may be still hyperæmic, infiltrated, and desquamating, and additional measures are required to restore it to the normal state. Moderately stimulating applications are now needed, and tar is the best agent for this purpose. Tar should never be applied in moist eczema. Its use should be reserved for dry and desquamating eczema. The various tars which have been used with success in eczema are the pix liquida or pine tar, the oleum fugi or beech tar, the oleum rusci or birch tar, and the oleum cadinum, obtained from the *Juniperis oxycedrus.* Tar penetrates all the layers of the skin, for when used externally it has been found in the urine. In a few patients it has been stated that its employment has been followed by rigors, fever, headache, and vomiting. If such symptoms arise, it should of course be discontinued. The following formulæ may be employed:

℞. Ung. picis liquidæ, ℥j;
Alcoholis, ℥ij. Misce.

℞. Olei rusci vel cadini, f℥j;
Alcoholis, f℥ii–iij. Misce.

℞. Olei rusci vel cadini, f℥j;
Alcoholis,
Ætheris, *āā.* f℥iss. Misce.

The alcoholic solutions of tar should be applied by a small bristle brush (Heitzman).

℞. Picis liquidæ, ʒj;
Adipis, ℥j. Misce.

℞. Picis liquidæ, ʒj;
Ung. zinci oxidi, ℥j. Misce. (Van Harlingen.)

Van Harlingen states that sulphur may be used with the tar, often with the best results. He employs the following formula:

℞. Sulphur. præcipitat.,
Picis liquidæ, *āā.* ʒss;
Ung. zinci oxidi, ℥j. Misce.

He adds that, like other tarry preparations, it should be used in small quantity and rubbed thoroughly into the skin.

In chronic eczema, in which the inflammation is mild and the surface scaly and dry, more stimulating applications are required than those recommended above. For such cases the following prescriptions will be found useful:

℞. Unguenti hydrarg. ammoniat., ʒij;
Unguenti zinci oxidi,
Unguenti aquæ rosæ, *āā.* ℥j.

Or,

℞. Pulv. hydrarg. chlor-mitis, gr. v;
Ung. zinci oxidi, ℥j. Misce.

Apply three or four times daily to the inflamed surface.

Constitutional Treatment.—No one line of treatment is suitable for every patient. Among the city poor strumous cases are common, and cases also in which, without any pronounced diathetic state, the cause is apparently a reduced state of the system from innutritious diet and other antihygienic conditions. Such cases require better diet and a mode of life more in accordance with sanitary requirements. On the other hand, I have observed cases of eczema which seemed to be produced or rendered more intractable by a plethoric state of the system, especially in the nursing infant, when the milk of the mother or wet-nurse was unusually rich or abundant. While, therefore, ill-nourished and weakly children require better regimen, with perhaps

vegetable and ferruginous tonics, the plethoric
though of a gentle kind. Their food should b
Indigestible articles, as pastries, cheese, and rich
especially when symptoms of indigestion are pr
aberration of the system from the healthy standa
rected. Saline aperients are useful in case of co
habit. The saline diuretics, as the acetate and ci
beneficial in acutę eczema with febrile symptom
rather scanty. The following formula is recomme

℞. Potassii acetatis,
Spts. ætheris nitrosi,
Syrupi aurantii,
Aquæ carui, q. s. a

One teaspoonful three times daily to a child of one year

In acute as well as chronic eczema any depar
ard, whether in the digestive organs, the kidneys,
should be corrected so far as possible, since ec
when the functions of the internal organs are

SCABIES.

The diseases of the skin previously cons
Scabies, on the other hand, is one of the most
tact. It is produced by an animal parasite, know
scabiei. The inflammation is caused by the fe
making for itself a canal or cuniculus, in which i
male does not burrow, but conceals itself under
result from the inflammation produced by its
sufficiently to produce a covering and shelter.
Eichstedt, Gudden, and others the female has bee
after being placed upon the skin to have conceal

FIG. 48.

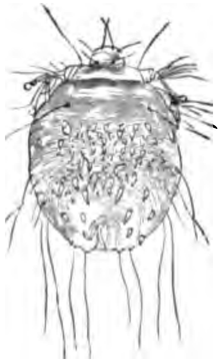

FIG. 49.

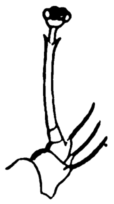

FIG. 51.

FIG. 48. The itch animalcule, *Acarus scabiei*, viewed upo
the arrangement of its spines and filaments. The female,
male, has a length of one-eightieth to one-sixtieth of an in
FIG. 49. The foot and last joints of the leg of the itch an
FIG. 50. The male itch animalcule, viewed upon the u
lobulated feet.
FIG. 51. Ova of the itch animalcule.

and the burrow which she constructs is arched a
lines in length, shorter or longer. The acarus
[illegible]n, when fully grown, be detected by the ey

The young acarus has six, the mature eight, articulated legs, with suckers upon the two anterior pairs and hairs on the posterior. The head, which can be elongated or retracted, is provided with two jaws. The upper surface is covered with spines directed backward so as to prevent retrogression in the burrow. She leaves behind her in the cuniculus, as she advances, her moulted skin, excreta, and eggs, which hatch on the eleventh day. The mother-acarus is always found at the remote end of the burrow, where it can be seen by the unassisted eye as a minute whitish or sometimes brownish speck, and from which it can be lifted by the point of a needle, to which it clings. The cuniculi can also be seen by the naked eye, looking, says Niemeyer, like the "scars of needle-scratches," and containing the young acari in various stages of growth.

The acarus by its burrowing produces an irritation and troublesome itching, which is the chief cause of the suffering of the patient. At the point where the acarus penetrates the cuticle the inflammation gives rise to a single, small, and acuminate vesicular or papular eruption, the cuniculus extending away from it. We often find ecthymatous pustules and abrasions intermingled with the vesicles, the result of frequent scratching. The itching is most intense and the acarus most active at night, when the patient is warm in bed. Scabies most frequently appears, especially in adults, first upon the hands, between the fingers, where the skin is thin, and it extends thence along the forearm and over the thighs and abdomen. In children it not infrequently occurs upon the buttocks, thighs, feet, etc., while the hands and forearms escape.

DIAGNOSIS.—Correct diagnosis is important, because the treatment required is different from that in any other exanthem, and because the suspicion of having this disease always renders one solicitous to know the exact nature of the eruption. Scabies can be diagnosticated from those diseases for which it may be mistaken by the following characters: its occurrence where the cuticle is thin and delicate, as between the fingers, along the anterior aspect of the forearm, upon the abdomen, thighs, and inside of the feet; small size, acuminate shape, and isolated position of vesicles; the intermingling with the vesicles of other forms of eruption, as papules and pustules, and the presence of linear scars and abrasions produced by the scratching; itching most intense at night; absence of fever; absence of the disease from posterior aspect of body and arms and from head and face. Scabies may be distinguished by the vesicular character of the eruption from all other exanthematic affections except eczema, sudamina, and herpes. Eczema is most common on the scalp and face, where scabies does not occur, and unlike scabies its vesicles are round and thickly aggregated in clusters; in eczema there is a smarting or prickling sensation very different from the intense itching of scabies. In herpes the vesicles are large, rounded, and in clusters, and attended by a burning or pricking sensation, with but little itching. The eruption in sudamina is vesicular and discrete, as in scabies, but it is globular and accompanied by no itching or other local symptoms.

TREATMENT.—As scabies is due to a species of acarus which burrows in the epidermis, it can only be treated successfully by measures which destroy this animalcule. If it be destroyed, the disease gets well of itself. Sulphur has been employed for a long period for this purpose, since sulphurous acid, which is evolved from the sulphur, is destructive to the animalcule. The unguentum sulphuris, if thoroughly applied, will rarely fail to eradicate scabies. The internal use of sulphur aids the external treatment, since a portion of the gas which is generated escapes through the pores of the skin. The chief objection to the employment of sulphur is its exceedingly unpleasant odor, which is noticeable, however disguised by perfume. Sulphur or any other substance employed externally has more effect if it be preceded by a

INDEX.

ACEPHALUS, 97
Acrania, 97
Albuminuria in diphtheria, 392
Albuminuria in scarlet fever, 300
Animal heat, 92
Aphthous stomatitis, 742
Appendicitis, 856
etiology, 857
anatomical characters, 858
symptoms, 859
diagnosis, 861
prognosis, 862
treatment, 863
Artificial feeding, 72
Atelectasis, 687
acquired, 687
symptoms, anatomical characters, 689
treatment, 690
Attitude in disease, 87

BATHING in infancy, 80
Blue disease, 106
Booker, W. D., investigations relating to intestinal bacteria, 781
Brain, incomplete, 98
in infancy and childhood, 520, 521
Brain, atrophy of, 522
hypertrophy of, 523
pathological anatomy, 523, 524
causes, 524
symptoms, case, 525, 526
diagnosis, 526
prognosis, treatment, 527
Thrombosis, 527
anatomical characters, 528
causes, 529
symptoms, diagnosis, prognosis, 530
treatment, 531
Congestion of, 531
causes, 531, 532
symptoms, anatomical characters, prognosis, 533
treatment, 534
Hemorrhage of, 534
Dropsy of, congenital, 542
acquired, 548
Bronchial phthisis, 234
Bronchitis, 677
causes, anatomical characters, 677–679
symptoms, 680
diagnosis, 682
prognosis, treatment, 683–687

CALCULI, 874
Cancrum oris, 744
Caput succedaneum, 117
Caries, vertebral, 637
causes, symptoms, diagnosis, 637–6
prognosis, treatment, 640
Catarrhal laryngitis, 644
Catarrhal pharyngitis, 756
Catarrh, intestinal, of infancy, 785
Cephalæmatoma, 117
Cerebro-spinal fever, 470
definition, 470
history, 470–472
etiology, 472
its contagiousness, 474
secondary, 476
sex, age, 477
symptoms, 478
mode of commencement, 479
nervous system, 480
digestive system, 485
pulse, temperature, 486
respiratory system, 487
cutaneous surface, 488
urinary organs, 488
special senses, 489
symptoms of endemic or naturali 490
nature, 491
anatomical characters, 492
prognosis, 495
diagnosis, 497
treatment, 498
curative, 498
internal, 501
Cerebro-spinal system, diseases of, 520
Chicken-pox, 353
Childhood, 35
changes of organs, 35
Cholera infantum, 799
anatomical characters, 800
nature, 802
diagnosis, prognosis, treatment, 8 808
Chorea, 608
causes, 609
sex, 609
uterine irritation, 610
anæmia, 610
rheumatism, 610
lesions of brain and spinal cord, 615
fright, 614
imitation, 614
intestinal irritation, 614
anatomical characters, 615
symptoms, 616
prognosis, course, 618
diagnosis, 619
treatment, 619

Circulatory system in infancy, 90
Clothing in infancy, 81
Colitis, 808
  causes, 808
  symptoms, 809
  diagnosis, 809
  prognosis, 809
  treatment, 810
Colostrum, 48
  constituents of, 48, 49
Congestion of brain, 531
  of spinal cord, 635
  of stomach, 771
Conjunctivitis, 120
  mild or catarrhal, 120
  purulent ophthalmia neonatorum, 121
    symptoms, 122
    course, results, 123
    preventive measures, 123, 124
    treatment, 125
Constipation of new-born, 155
    causes, 156
    symptoms, 157
    treatment, 158
Constipation, symptomatic, 811
  idiopathic, 813
    causes, 813-815
    symptoms, 815
    treatment, 817
      hygienic, 818
      therapeutic, 820
Consumption, 221
Convulsions, clonic, 570
  internal, 590
    causes, 591
    anatomical characters, symptoms, 592
    case, 593
    diagnosis, prognosis, mode of death, 594
    treatment, 595
Coryza, 641
  anatomical characters, 641
  symptoms, prognosis, treatment, 642
Cough, nervous, 737
    causes, 737
    treatment, 737, 738
Cranial sinuses, thrombosis in, 527
Craniotabes, 190
Croup, false or spasmodic. (See *Spasmodic Laryngitis*, 646.)
Croup, membranous (diphtheritic), 650
    etiology, 650 653
    anatomical characters, 654
    symptoms, 655
    diagnosis, 656
    prognosis, 659
    treatment, preventive, 660
      internal, 663
      surgical, 666
  intubation in, 667 676
  tracheotomy in, 675
Cryptorchia, 874
Cyanosis, 106
  its literature, 106
  sex, time of commencement, 107, 108
  symptoms, 108-110

Cyanosis:
  nature
  mode o
  morbid
  theorie
  treatme

DACTY
    sy
Dentition
  patholo
  diagno
Dentition
Diagnosis
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    ne
Diarrhœa
    treat
Diarrhœa
    cause
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Diarrhœa
    etiol
    age,
    denti
    anat
Diarrhœa
    treat
Digestive
Digestive
Dilation
Diphther
Diphther
  history
  etiolog
  mode o
  contrac
  age, 36
  incubat
  nature,
  diagno
  pultace
  scarlati
  gangre
  herpeti
  ulcero-
  anatom
  the blo
  brain a
  tonsils,
  faucial
  vesicul
  pulmo
  lymph
  heart,
  spleen,
  sympto

Diphtheria: temperature, 388
  nares, 389
  eye, ear, mouth, 389, 390
  œsophagus, stomach, intestines, 390
  genito-urinary organs, 391
  skin, 392
  albuminuria, 392
  paralysis, 395
  clinical history, 396
  time of commencement, 397
  loss of tendon reflexes, 398
  palatal paralysis, 399
  multiple paralysis, 400
  cardiac paralysis, 401
  etiology, 406
  prognosis, 411
  preventive treatment, 413
  treatment, 416
  hygienic, 417
  stimulants, 418
  quinine, tinctura ferri chloridi, potassium chlorate, 421
  hydrargyri chloridum corrosivum, 423
  calomel, 425
  turpentine, 426
  pilocarpine, sodium benzoate, 427
  treatment, local, solvents, 428
  albuminuria, 429
  paralysis, 429
Dyspepsia, 765
Dysuria, 874

ECLAMPSIA, 570
    causes, 571
  premonitory stage, symptoms, 572
  partial eclampsia, 573
  anatomical characters, 574
  diagnosis, prognosis, 574, 575
  treatment, 576
Eczema, 883
  anatomy, 883
  etiology, varieties, symptoms, 884
  diagnosis, 885
  treatment, 886
Empyema, 712, 729
Encephalocele, 100
Endocarditis in rheumatism, 506
Enteritis, 808
  causes, 808
  symptoms, diagnosis, 809
  prognosis, treatment, 809, 810
Entero-colitis, 785
Enuresis, 866
  etiology, 868
  prognosis, treatment, 870
Epilepsy, 578
  etiology, predisposing causes, 578
  age, exciting causes, 578, 579
  symptoms, minor and major attacks, 580
  aura, 580–582
  anatomical characters, 583
  pathology, 584
  diagnosis, 585
  prognosis, treatment, 586–589
Erysipelas, 512
  point of commencement, causes, 514
Erysipelas: premonitory symptoms, 515
  symptoms, 516
  prognosis, duration, 517
  modes of death, pathological anatomy, 517, 518
  treatment, 518
Erythema, 877
  prognosis, diagnosis, treatment, 878
Exercise in infancy, 83

FEEDING, infantile, 64
    over-feeding, 64
  insufficient, 65
  improper, 66, 67
  quantity of food required, 68
  statistics, 69
Feeding, artificial, 72
Fever, intermittent, 449
Fever and ague, 449
Fœtus, effects of maternal impressions on, 36
Follicular gastritis, 777
Fright a cause of chorea, 619

GALACTAGOGUES, 56
  Gangrene of mouth, 744
  anatomical characters, 744
  causes, symptoms, 745
  diagnosis, 746
  prognosis, 747
  treatment, 748
Gastritis, 771
  cause, 777
  age, 772
  symptoms, anatomical characters, 773
  diagnosis, prognosis, treatment, 774
  follicular (diphtheritic), 775
Gastro-intestinal bacteria, 779
Gastro-intestinal hemorrhage, 150
Gastro-malacia, 776
  case, 777
German measles, 328
Glands in scrofula, 207
Glottis, spasm of, 590
Green color of the stools, 780
Growth of infants, 43

HÆMATEMESIS and melæna neonatorum, 150
  age, 150
  etiology, 151
  diagnosis, prognosis, treatment, 153
Heart-malformations, 104
Hemorrhage, intracranial (meningeal, cerebral), 534
    causes, anatomical characters, 535
    meningeal, 536
    cerebral, 537
    symptoms, 538
    capillary, 539
    symptoms in meningeal, 540
    diagnosis, prognosis, treatment, 541
Hemorrhage, umbilical, 128
Hemorrhage, gastro-intestinal, 150
Hooping-cough, 431
Hydrencephalocele, 100

Hydrocephalus, congenital, 542
  anatomical characters, 542
  etiology, symptoms, 545
  prognosis, treatment, 547
Hydrocephalus, acquired, 548
  causes, 548
  anatomical characters, symptoms, 549
  prognosis, treatment, 550
Hydrocephalus, spurious, 566
  anatomical characters, case, 566
  symptoms, 567
  causes, 568, 569
  diagnosis, prognosis, 569
  treatment, 570

ICTERUS neonatorum, 132
  theories of its causation, 133–135
  prognosis, treatment, 135
Indigestion, 765
  causes, 765
  symptoms, 766
  prognosis, 767
  diagnosis, treatment, 768
Infancy, 33
  organs in, 34
  mental faculties in, 34
Infantile paralysis, 624
Infarctions, uric-acid, 866
Inflammation of sterno-cleido-mastoid muscles, 118
Intermittent fever, 449
  etiology, 450
  symptoms, 451
  treatment, 453
Internal convulsions, 590
Intestinal catarrh of infancy, 785
  etiology, 787
  age, dentition, 791
  symptoms, 792
  anatomical characters, 797
  diagnosis, 798
  prognosis, 799
  Infantile cholera, or choleriform diarrhœa, 799
    nature, 802
    diagnosis, prognosis, 803
    treatment, 803–808
Intestinal worms, 822
Intracranial hemorrhage, 534
Intubation, 668
  difficulties of operation, 671
  accidents and dangers of, 672
    asphyxia, 673
  mode of extraction, 674
  after-management, 674
Intussusception, 837
  without symptoms, 837
  with symptoms, 838
  previous health, causes, 838
  age, seat, pathological anatomy, 839
  in small intestines, 839
    cases, 840–842
  in large intestines, 842
    symptoms, 844
    diagnosis, 846
    duration, prognosis, 846, 847

Intussusce
  treat

JAUND
Joint

KERAT
herp
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Kidneys
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LACTA
bil
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Mamma
Mastitis,
Measles,
etiol
com
anat
diag
Germa
Meconiu
Membra
Meninge
Meningi
age, 5
pathol
causes,
premo

Meningitis: symptoms, 558
  case, 561
  diagnosis, prognosis, 562
  treatment, 563
Meningocele, 100
Milk, human, 49
    composition, 50
    modification from diet, 50
      from insufficient food, 50
      from retention in breast, 51
      by age and mental impressions, 51
      by catamenial function and by pregnancy, 52
    difference in quantity and quality, 54
    effect of medicines, 54
    rules in regard to nursing, 55
    scantiness: cause, treatment, 55
Morbilli. (See *Measles.*)
Morbus cæruleus. (See *Cyanosis.*)
Mortality of early life, causes, 39
      internal malformations, 40
      feebleness of system, 40
      hereditary disease, 40
      infectious disease, 40
      anti-hygienic conditions, 41
      improper food, 42
Mother, care of, in pregnancy, 35
Mouth, inflammation of, 739
  gangrene of, 744
Muguet, 145
Mumps, 445
  etiology, incubation, 445
  symptoms, anatomical characters, 446
  complications, sequelæ, 446, 447
  diagnosis, prognosis, treatment, 447, 448
Myelitis, 624

NECROSIS, 744
  Nephritis in diphtheria, 392
Nephritis in scarlet fever, 300
Nervous cough, 737
Nervous system in infancy, 94
Newly-born, diseases of, 97
Noma, 744
Nurse, selection of, 59

OBSTETRICAL scarlatina, 279
  Œdema neonatorum, 176
Œsophagitis, 763
  anatomical characters, treatment, 764
Oïdium albicans. (See *Thrush.*)
Ophthalmia, strumous, 217
  herpetic or phlyctenular keratitis, 217
  duration, diagnosis, prognosis, 218
  treatment, 218, 219
  parenchymatous or diffuse keratitis, 220
Otitis in scarlet fever, 296

PAPULAR diseases, 882
  Paralysis, 621
  causes: a change in the blood, 621
    reflex influence, 621
    injury of a nerve, 621
    anatomical change in muscular fibres, 621
    disease of nervous centres, a case, 622
Paralysis: Poliomyelitis acuta anterior, 624
    symptoms, 624
    diagnosis, prognosis, etiology, 625–627
    treatment, 628
Paralysis, facial, 630
    causes, symptoms, 630
Paralysis, pseudo-hypertrophic, 631
    symptoms, 631, 632
    anatomical characters, causes, 633
    prognosis, treatment, 634
Parotiditis, 445
Pemphigus neonatorum, 177
  simplex, 177
  cachecticus, 178
  anatomy, treatment, 178
Peptonized milk, 75
Peripharyngeal abscess, 759
    age, causes, 759
    anatomical characters, symptoms, 760
    diagnosis, 762
    prognosis, treatment, 763
Perityphlitis, 856
  etiology, 857
  anatomical characters, 858
  symptoms, 859
  diagnosis, 861
  prognosis, 862
  treatment, 863
Pertussis, 431
  incubative period, age, causes, 432
  pathological anatomy, 433
  symptoms, first period, 434
    second period, 434
    third period, 435
  complications, 436
  diagnosis, prognosis, 439
  treatment, 440
    carbolic acid, cocaine, antipyrine, 441
    quinine, 442
    sulphur, 443
    prophylaxis, 445
Pharyngitis, catarrhal, 756
    anatomical characters, 756
    symptoms, prognosis, diagnosis, 757
    treatment, 758
Phlebitis, 527
Phthisis, 221
Pleurisy (pleuritis), 704
  frequency, 704, 705
  causes, 705–707
  anatomical characters, 710
  plastic, 711
  sero-fibrinous, 711, 712
  purulent, 712
  hemorrhagic, 713
  symptoms, 716
  physical signs, 718
    palpitation, 719
    percussion, 719, 720
  auscultation, 720
  diagnosis, 721
  prognosis, 723
  treatment, 725
    internal, 726
    thoracentesis, 728
    empyema, 729

- Pleurisy: treatment: mode of operating, 730
    - admission of air, 733
    - injury to lung by instruments, 734
    - washing pleural cavity, 734
    - extraction of portion of ribs, 736
- Pneumonia, 690
    - catarrhal, etiology, 690–693
    - croupous, etiology, anatomical characters, 693–696
    - septic or embolismal, 696
    - cheesy, 696
    - symptoms of croupous, 398
    - physical signs, 699
    - diagnosis, 700
    - prognosis, treatment, 701
- Post-mortem gastric softening, 776
- Pott's disease, 637
- Pregnancy, care of mother in, 35
- Pseudo-membranous croup, 650
- Pulse in health, 90
    - in disease, 91
    - influenced by excitement, 91

- RACHITIS, 179
    - frequency, 179, 180
    - age, 181
    - causes, 182
    - anatomical characters, 186
    - cartilaginous changes, 186
    - osseous changes, 186
    - pathology of, 188
    - anatomical characters in stage of deformity, 188
    - changes in cranial bones, 189
    - craniotabes, 190
        - symptoms, 190, 191
        - changes in vertebræ, 192
            - in maxillæ, 193
            - in ribs, 194
            - in bones of upper extremity, 196
            - in bones of lower extremity, 196
        - effect on dentition, 198
        - changes in soft tissues, 198
        - reconstruction, 199
        - symptoms of rachitis, 200
        - complications and sequelæ, 201
        - diagnosis, prognosis, 201–203
        - treatment, 203
- Remittent fever, 454
    - symptoms, diagnosis, prognosis, 455
    - treatment, 455, 456
- Respiratory system, diseases of, 641
    - in infancy, 87
- Retropharyngeal abscess, 759
- Rheumatism, acute, 503
    - causes, 504
    - symptoms, 505
    - duration, prognosis, diagnosis, 509
    - treatment, 510
- Rheumatism, scarlatinous, 297
- Rickets, 179
- Roseola, 879
    - symptoms, causes, prognosis, diagnosis, 880
    - treatment, 881
    - Rötheln, 328
- Rötheln: premonitory stage, 330
    - symptoms, (*a*) tegumentary system, 3
        - (*b*) mucous membrane, 331
        - respiratory and digestive system, 3
        - pulse, temperature, 332
        - complications, prognosis, 332
    - nature, incubative period, contagi ness, 332–335
    - complications, diagnosis, 335
    - prognosis, treatment, 336
- Rubeola. (See *Measles.*)

- SCABIES, 890
    - cause, 890
    - diagnosis, 891
    - treatment, 891, 892
- Scarlet fever, 271
    - etiology, 271
    - incubative period, 274
    - contagiousness, 275
    - variations in type, 276
    - surgical scarlatina, 276
    - obstetrical scarlatina, 279
    - age, 280
    - clinical facts regarding scarlet f 281
    - symptoms, ordinary form, 283
        - grave form, 287
        - irregular form, 288
    - complications and sequelæ, 289
        - nervous accidents, 290
        - inflammation of the faucial su 291
        - diphtheria, 293, 294
        - inflammation of middle ear, 29
        - scarlatinous rheumatism, 297
        - pleuritis, 298
        - dilation of the heart, 299
        - nephritis, dropsy, 300
        - parenchymatous nephritis, prol tion of nuclei, 301
        - interstitial nephritis, 303
    - anatomical characters, 305
    - diagnosis, 306
    - prognosis, 308
    - treatment, 310
        - prophylaxis, 310
        - hygienic, 313
        - therapeutic, 313
        - mild cases, 313
        - ordinary and severe cases, 314
        - antiseptic, 318
        - complications and sequelæ, 328
- Sclerema neonatorum, 174
- Scrofula, 205
    - causes, 205
    - anatomical characters, 206
    - dactylitis, 208
    - symptoms, 209
    - prognosis, 211
    - treatment, 212
- Sepsis of new-born, 136
    - first group, cases, 137, 140
    - second group, cases, 140, 143
    - third group, cases, 143, 145

Skin diseases, 877
Sleep in infancy, 82
Smallpox, 336
Spasm of the glottis, 590
Spina bifida, 101
    diagnosis, prognosis, treatment, 102, 103
Spinal cord, diseases of, 634
    congestion of, 635
    anatomical characters, symptoms, 636
    treatment, 636, 637
    vertebral caries, 637
Stomach, congestion of, 771
  inflammation of, 771
  dilatation of, 775
  softening of, 776
Stomatitis, simple, 739
    causes, symptoms, appearances, treatment, 739, 740
Stomatitis, ulcerous, 740
    causes, symptoms, prognosis, treatment, 740, 741
Stomatitis, aphthous, 742
    causes, symptoms, diagnosis, prognosis, treatment, 743
Stomatitis, gangrenous, 744
    anatomical characters, 744
    causes, symptoms, 745
    diagnosis, 746
    prognosis, 747
    treatment, 748
St. Vitus' or St. Guy's dance, 608
Strophulus, 882
  varieties, 882
  treatment, 883
Strumous ophthalmia, 217
Syphilis, 251
  etiology, 251
  clinical history, 253
  coryza, mucous patches, 255
  roseola, pemphigus, acne, impetigo, ecthyma, 256
  visceral lesions, 257
  osseous lesions, 258
  dactylitis syphilitica, 259
  prognosis, 259
  treatment, 260

TÆNIA solium, 826
    saginata, 827
    elliptica, 827
Teething, 750
Tetanus neonatorum, 159
    causes, 160
    period of commencement, 161
    frequency in certain localities, 162
    causes, 163
    symptoms, 170
    mode of death, prognosis, 171
    duration in fatal and favorable cases, 172
    diagnosis, preventive treatment, 172, 173
    treatment, 173, 174
Tetany, 597
  causes, 597, 600
Tetany: symptoms, 601
  cases, 602, 605
  pathology, diagnosis, 606
  prognosis, treatment, 607
Thoracentesis, 728
Thread-worms, 823
Thrombosis in cranial sinuses, 527
Thrush, 145
  causes, 145
  anatomical characters, 146
  symptoms, 147
  diagnosis, prognosis, 148
  treatment, 149
Tracheotomy, 675
Tubage in membranous croup, 668
Tuberculosis, 221
  etiology, 221
  anatomical characters, 224
      in infancy and childhood, 225
  tubercles in lungs, 226
  cavities, emphysema, 228
  tubercles in abdominal viscera, 230
  stomach and intestines, 230
  general symptoms, 231
  encephalon, 232
  in tubercles of bronchial glands, 234
  physical signs, 235
  in tubercles of pleura, 237
  in tubercles of stomach and intestines, 237
  diagnosis, 237
  prognosis, 240
  prophylaxis, 241
  treatment, 243
Typhlitis, 856
Typhoid fever, 456
    causation, 456
    anatomical characters, 459
    pathology, 460
    incubative period, symptoms, 461
    duration, 462
    complications, 463
    diagnosis, 464
    prognosis, 465
    treatment, 465–469
    prophylaxis, 469, 470

ULCEROUS stomatitis, 740
  Umbilicus, diseases of, 127
      vegetations of, 127
      prognosis, diagnosis, treatment, 128
  hemorrhage of, 128
      sex, age, causes, 129, 130
      symptoms, prognosis, treatment, 131, 132
Uric-acid infarctions, 866
Urine, incontinence of, 870
Urticaria, 881
  causes, diagnosis, prognosis, treatment, 881

VACCINIA, 345
    appearances, symptoms, 348
  anomalies, complications, sequels, 349
  erysipelas, syphilis, 349, 350
  subsequent vaccinations, 350
  protection from vaccination, 351

Vaccinia: selection of virus, 352
Varicella, 353
  symptoms, 354
  diagnosis, prognosis, treatment, 355
Variola, 336
  etiology, 336
  incubative period, stage of invasion, 337
  stage of eruption, 338
    of desiccation, 338
    of desquamation, 339
Varioloid, 340
  mode of death, 340
  anatomical characters, 341
  complications, 341
  diagnosis, 342
  treatment, 343
Vaughan, Dr. V. C., remarks on intestinal bacteria, 781
Vertebral caries, 637
Vulvitis, 875
  etiology, 875
  treatment, 876

WEANING, 62
  Weight of infant, 43
Wet-nurse,
  syphilis i
  character
  lactomete
  lactoscop
  use of mi
  micro-org
  return of
  course of
  weighing
Whooping-
Worms, int
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